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PAPER TRADE JOURNAL

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Kimberly-Clark to Spend Millions on Plant

Expansion and Modernization In Progress At Kimberly-Clark Corp. Mills Represent Expenditures of About $3,500,000—Extensive Improvements of Mill At Kimberly Includes the Rebuilding of No. 4 Paper Machine.

[FROM OUR REGULAR CORRESPONDENT]

NEENAH, Wis., January 2, 1940—Expansion and modernization in progress at the Kimberly-Clark Corporation mills in Wisconsin and New York State will represent expenditures of approximately $3,500,000 for the years 1939 and 1940, according to details revealed by S. F. Shattuck, vice-president.

Rehabilitation of No. 1 machine is in process at the Badger-Globe mill at Neenah for the manufacture of coarse wadding for insulation of homes, automobiles and refrigerators. When completed, these operations will be transferred from the Niagara Falls, N. Y., mill, where this new line of production has been developed. The alterations are expected to be completed in April, and the new insulation will be placed on the market in November. The interior of the mill will be revamped for the conversion of coarse wadding into salable products. Toilet and locker facilities will be modernized, and cafeteria equipment will be installed.

New Building for Wadding Department

Anticipating growing production needs in the coarse wadding field, the corporation plans to erect a new building 76 by 240 feet between the canal and the Badger-Globe buildings. It will be two stories and basement, of concrete and steel, following modern architectural design. One high speed crepe wadding machine will be installed upon completion, with room allotted for another as the demand develops. It is estimated this expansion will mean the addition of 200 more employees.

Progress is already being made on the construction of a new bridge over the Fox River canal to provide an additional trucking outlet, and on the relocation of railroad sidings. Old buildings in the path of the project are being demolished.

Other Neenah improvements will include the installation of air-conditioning equipment in the older portions of the main office building prior to the 1940 summer season.

Modernization of Mill at Kimberly

At the corporation's mill at Kimberly, Wis., extensive modernization of the finishing room has been in progress, involving an extension 53 by 190 feet, and construction of a frame shop. A one-story roll storage building 193 by 53 feet also has been added. A new 154-inch roller bearing supercalender stack has been installed, with a speed of 1,500 feet per minute. In addition, an existing 140-inch stack was transferred to Kimberly from the Niagara Falls, N. Y., mill.

No. 4 paper machine will be torn down completely during 1940 and rebuilt to make an improved type of direct coated paper. A new Allis-Chalmers 5,000 K.W. turbine and gear-driven generator will be installed in the turbine room. Orders also have been placed for an additional pulverizer, two boiler feed pumps, and water treating equipment.

Nineteen company-owned homes in the Kimberly mill village have been modernized, and 14 are under purchase by renters. Twenty more will likewise be reconditioned and modernized in 1940.

New Steam Plant Erected at Niagara Mill

At the Niagara, Wis., mill, an entirely new boiler house has been constructed and new boilers are being installed. The installation will have steam generating capacity of 180,000 pounds per hour at a pressure of 510 pounds, and a temperature of 700 degrees Fahrenheit.

Pulp production improvements at Niagara include a new 30-ton Diesel locomotive crane for handling wood, and replacing of wooden acid tanks and building with a new and modern structure equipped with stainless steel tanks. Supercalender stacks also will be redesigned and modernized and equipped with roller bearing mountings.

Install Machine in Fenimore Mill

[FROM OUR REGULAR CORRESPONDENT]

GLEN FALLS, N. Y., January 2, 1940—An additional paper machine is being installed at the Fenimore branch of the Union Bag and Paper Corporation in order to permit the making of high grade specialties in the bag paper quality line. The machine was moved here from the branch at Kaukauna, Wis., and will be placed in operation early in January. It is a 72-inch machine and is expected to provide work for about twenty additional hands. Indications are that the local branch will be busy for some time with a full complement of workers. The closing of the Wisconsin mill will also probably result in increased production here.

Canadian Newsprint Outlook Best in Years

Cooperation of Manufacturers Helped To Make Past Year One of Best In Decade — Production Near 80 Per Cent — Exports of Newsprint Doubled In November and Value Put At $131,509,078 For 11 Months.

[FROM OUR REGULAR CORRESPONDENT]

MONTREAL, Que., January 2, 1940—The newsprint industry in Canada enters upon the New Year with prospects brighter than they have been at any time during the past decade. Only a few years ago practically every newsprint manufacturing company in Canada was bankrupt and half of the country's newsprint machines were lying idle. The excess capacity was such that some authorities declared it would take 30 years for consumption to catch up with it. There followed a period of drastic financial reorganization and—equally important—a period in which the leaders of the industry got together under the motto, "United we stand, divided we fall." After Herculean efforts and the acceptance of tremendous losses by investors, the various companies one by one were reorganized, cut-throat competition was abolished and cordial cooperation established between all producing units.

Cooperation Made 1939 Good Year

The past year has been one in which the first fruits of this "new order" began to appear, assisted, it must be admitted, by fortuitous circumstances, to which in the last quarter wartime conditions contributed. Due to the establishment of a better price level, to increased newsprint consumption, to interruption of supplies from competitive resources, and to a premium of 10% on payments in U. S. dollars, the newsprint industry has gone along way towards rehabilitation. Production has for some time past been at the rate of around 80% of capacity, and the finances of the various companies have so improved that a beginning has been made by some of them on the payment of dividends on their premier securities.

Statistics Tell the Tale

Complete statistics for the year are not yet available, but those to the end of November indicate that, without taking into account the premium on payments from United States, to which country most of the output of Canadian mills is shipped, gross receipts by the industry here for the past year will average close to an extra million dollars for every month in the year, this of course including sales on the domestic market.

Newsprint Exports Double in Year

Figures just released by the Dominion Government show that in November the exports of newsprint amounted to 5,079,939 cwt., valued at $11,232,352, as compared with 4,916,253 cwt., valued at $10,838,543 in November, 1938. For the 11 months to the end of November, total exports reached 48,068,643 cwt., valued at $104,440,675, as compared with 44,264,059 cwt., valued at $95,565,170, in the similar period of 1938. Of the November exports 4,423,109 cwt., valued at $9,758,919, went to the United States. Australia took 236,747 cwt., valued at $602,429; the United Kingdom, 115,570 cwt., valued at $212,371; and Argentina 100,028 cwt., valued at $198,208. The remainder went to no fewer than 36 other countries.

Exports of Wood Pulp Valued at $3,435,729

Exports in wood pulp in November amounted to 1,583,573 cwt., valued at $3,435,729, as compared with 1,077,489 cwt., valued at $2,493,187 in November, 1938. For the 11 months to the end of November total exports of wood pulp amounted to 12,110,018 cwt., valued at $27,068,403, as compared with 10,086,442 cwt., valued at $25,395,578 in the similar period of 1938.

Thus for the 11 months the total exports of newsprint and pulp were valued at $131,509,078, as compared with $120,960,748 for the similar 11 months in 1938, an improvement of $10,548,330.

Newfoundland Newsprint for Australia

From St. John's, Newfoundland, it is reported that, in a new trade agreement, arrangements have been made for a reciprocal reduction of customs duties between Newfoundland and Australia which will facilitate the export of newsprint to the latter country. This will remedy a situation by which, when previous Australian customs regulations gave a preference to newsprint imported from the United Kingdom and Canada, Newfoundland by an oversight was left out of the arrangements.

Veldown Increases Production

[FROM OUR REGULAR CORRESPONDENT]

GLENS FALLS, N. Y., January 2, 1940—Improvements have been made at the Veldown Company, Inc., which will enable a substantial increase in production besides an enlargement of the force. A new machine for the manufacture of tissue was placed in operation this week after several weeks of installation work and an official of the concern stated that the output is sold far ahead with enough orders to guarantee six months of steady operation on a schedule of twenty-four hours a day. The management announced that the new machine will provide employment for about fifty additional persons, most of whom have been placed on the payroll already to bring the total number to about 185 hands. It was also stated that the Veldown Co., a branch of the International Paper Co., has enjoyed an increase in business of about forty per cent this year and a steady rise during the last four years. The plant has been operating twenty-four hours a day, seven days weekly, and there are no indications of a slowing up in operations.

Booth Moves Toronto Office

The office of J. R. Booth, Limited, Ottawa, in Toronto, has been removed from 33 Front St., West to 1027 Commerce & Transportation Building. N. D. Bennett is the representative of the firm for Ontario in the sale of board and specialty papers and associated with him is H. E. Oyler.

Consolidated to Increase Production Soon

Production In Mills of Consolidated Water Power & Paper Co. Expected To Rise To 400 Tons Daily Next Month — Timber Owners Withdraw Lands Subject To Tax—To Fight the Wisconsin Corporation Tax.

[FROM OUR REGULAR CORRESPONDENT]

APPLETON, Wis., January 2, 1940—Production at the Consolidated Water Power and Paper Company's mills will reach approximately 400 tons daily when in February its machine alterations at the Wisconsin Rapids and Biron divisions are completed. With the completion of rebuilding of No. 1 machine at Wisconsin Rapids, six machines will be running on the Consolidated coated stock made under tis patented process directly on the paper machines. Rebuilding of a machine at the Biron division was completed recently.

Expressing his views as to the outlook for 1940, George W. Mead, president, said:

"Looking toward the New Year, I hesitate to make any prophecy concerning business. The European situation can cause only suffering and confusion. Business prosperity due to hostilities is neither real nor lasting and every right thinking business man in this country hopes for an early peace.

"During 1939 our mills have run quite full, particularly in the latter half of the year. We have gone ahead with plans for expansion, trusting the condition of the trade will warrant it.

"There is no certainty of business prosperity; however, I join with others in an expression of hope that the world will right itself and that business and industry will function substantially and usefully."

Thilmany Reconstructing oFrmer Bag Plant

Thilmany Pulp and Paper Company, Kaukauna, Wis., is making rapid progress on reconstruction of the former Union Bag and Paper Company plant, also to house part of the converting department. The also a house part of the converting department. The building will be completed within about a month, according to F. W. Pinkerton, business manager of the C. R. Meyer Construction Company, which has the contract.

A former machine shop and storeroom quarters have been torn down and the large smoke stack is being removed after the boilers have been taken out. All of the old machinery and piping have been taken out. A new concrete floor has been laid in the basement and new wood flooring is being installed on the first floor. New steel construction was added to overcome a floor sag.

Building of a concrete wall along the canal front has been completed to close off the head race, permitting enlargement of the driveway to the main building. Sidetracks also are being extended to facitate loading operations. Fifty men are employed on the project, and have conducted their dangerous work without an accident.

Work on Alumina Sulphate Plant Started

Workmen have completed the concrete foundation for the new aluminum sulphate factory of the General Chemical Company at Menasha, Wis., and are installing a metal tank large enough to hold the contents of a tank car. The superstructure, one story, will be built of steel, supplied by Blaw-Knox Company of Pittsburgh. A steel fence will be erected around the property. The building is 50 by 100 feet in size, and the cost is estimated at $12,000. It will be completed within about six weeks.

Pulp Shipments Swell Great Lakes Tonnage

Movement of pulp and pulp wood helped to swell the shipping total on the Great Lakes during 1939 to the highest level in years. Reports compiled by the War Department show that 40,000 tons of pulp were unloaded at the docks at Ashland, Wis., on Lake Superior. The pulp was transported by rail to various Wisconsin mills, and a part of the supply went to the tissue division of the Marathon Paper Mills Company, at Ashland. Milwaukee, Green Bay and Manitowoc ports also reported extensive movement of raw materials to the paper mills.

Company To Fight Corporation Tax

The Minnesota Mining and Manufacturing Company of St. Paul, Minn., which has a sandpaper and abrasive branch at Wauwau, Wis., is one of the three firms participating in lawsuits before the Wisconsin Supreme Court. The company contends a law taxing corporations three per cent on dividends declared is illegal because Wisconsin could not justly allocate portions of its interstate earnings to a particular state, and because it is a "foreign" corporation. The law became effective in September, 1935. It is expected the case will be carried to the United States Supreme Court. The other suits were brought by J. C. Penney Company and F. W. Woolworth Company.

Timber Owners Withdraw Lands

Some of the timber owners in northern Wisconsin are withdrawing their lands from entry under the Wisconsin forest crop law, which calls for an annual tax of ten cents per acre, and a severance tax at the time the timber is cut. It has been found that the decrease in land values makes it cheaper for the owners to pay the regular property tax assessed by the northern counties. The state has also stiffened the requirements under the forest crop law, requiring owners to sponsor forest growth. Although lands are withdrawn, they can be reentered under the law if a new application is made.

Probst-Wichmann Nuptials

The marriage of Miss Lucille Wichmann and Dr. T. Richard Probst, both of Appleton, Wis., took place December 22 at the parsonage of the Presbyterian church at Kiel, Wis., where the bride has been a musical instructor. Dr. Probst is a graduate of Penn State College, and received his Ph. D. degree at the Institute of Chemistry at Appleton, Wis. He is associated with the Gilbert Paper Company, Menasha.

Toronto Reports Outlook for 1940 Bright

Mills Had Good Year In 1939 and Jobbers Had Better Profits But Results Failed To Equal Year of 1937—New Plan For Lake Sulphite Pulp Co. —Ontario Pulpwood Used In 15 Wisconsin Mills — Other Late News.

[FROM OUR REGULAR CORRESPONDENT]

TORONTO, Ont., January 2, 1940—Another year has passed in the history of the pulp and paper trade and in many respects it has been encouraging. There were very few changes in prices and it was not until the outbreak of hostilities in Europe in September that all quotations were withdrawn by the mills and jobbers. A rush of orders set in and for a while there was a deluge of requests for tonnage on all lines. Newsprint and wrapping papers were the only varieties on which there was no change in quotations, and on all other grades, whatever prices prevailed at the time of delivery ruled. The mills were for a while swamped with orders and most of them in book, writing, coated paper and specialty lined stepped up production to the highest point of the year. It is expected that new price lists will be issued shortly and that the average raise will be about half a cent.

Buying Splurge Recedes in Last Few Weeks

The wave of buying fell off during the past few weeks and consumers who had allowed their stocks to fall to a low point, are now protected for a while and will probably not add to their holdings until the inventory period of this month is over. All the mills had a good year as will be revealed by the annual reports and most jobbers report that turn over and profits were somewhat better than in 1938 but will not equal the splendid showing which the majority of them made in 1937. Canadian paper mills have been commended for maintaining firm values in view of the higher prices they must now pay for their raw products.

As already intimated, increased prices now seem inevitable as the mills must meet a substantial advance on pulp working for several months at capacity with orders running behind, the demand has been showing signs of easing up. The calls came from box, envelope and stationery manufacturers. Despite the efforts of the mills to promote orderly buying not a few printers did their best to stock up in anticipation of higher prices. After the declaration of war the commercial printing trade following a quiet summer regained much lost ground.

Outlook for Paper Industry Bright

The outlook for the industry in 1940 appears bright and Canadian newsprint mills should enjoy a larger average of production than they did in 1939, according to the judgment of leading representatives of the trade. Shipments of newsprint to Europe will probably show a decline but it is thought that Canadian exports to the United States will gain and that an increase in tonnage may be expected from other countries which formerly got a large portion of their supplies from Europe and Scandinavia. The producers of pulp of different grades are expecting a stronger demand and will certainly get higher prices. All pulp plants are now operating to capacity.

Low Prices Cut Hinde-Dauch Profits

While production of the Hinde & Dauch Paper Company, Limited, during the year just closed was somewhat greater than in 1938, due principally to demands incidental to the European conflict, profits will not be as large as last year because for most of that period selling prices were extremely low, says L. F. Winchell, vice president and general manager of the company. The directors, however, feel that the year was satisfactory and that further definite progress has been made in processing in the better qualities and in the strengthening of the relationship both with customers and employes.

New Plan for Lake Sulphite Pulp Co.

In connection with the reorganization of the Lake Sulphite Pulp Company, Limited, Red Rock, Ont., one of the plans that is being given consideration as a basis that would require considerably less money than the $6,000,000 generally considered necessary for the completion of the plant, is the construction of a unit for the manufacture of unbleached sulphite pulp. The original proposal was for a bleached sulphite mill and later it was planned as a rayon pulp development. It is estimated, however, that an unbleached sulphite mill could be completed for a little less than $3,500,000. There is now a strong demand from the United States for unbleached, as well as bleached sulphite and for the first quarter of 1940 the contract price has been raised $10 to $50 a ton duplicating the $10 increase in bleached sulphite to $60.

Ontario Pulpwood Used in 15 U. S. Mills

In a recent address in Toronto, Hon. R. B. Bennett, former Premier of Canada, now residing in England, stated that a paper mill in Wisconsin is now operating on 400,000 cords of pulpwood exported to it from Ontario and that the mill would not be able to survive but for this supply. Hon. Peter Heenan, Minister of Lands and Forests for Ontario, has replied to Mr. Bennett and declares that no mill in Wisconsin or any other place is getting 400,000 cords of pulpwood from Ontario this year or any other year. The contribution from Ontario to Wisconsin runs from 40,000 to 232,000 cords at the most and this is spread over fifteen mills. The largest mill in Wisconsin uses only 165,000 cords annually.

Pulp Recovery Co. Chartered

A federal charter was recently granted the Pulp Recovery Company of Canada, Ltd., with an authorized stock of $100,000 and headquarters in Montreal. One of the directors is Wm. Earle Walker, merchant, of Westmount, Que., and a plant will be located at Hawkesbury, Ont. Due to winter weather, Mr. Walker states that it is doubtful if the proposition will be in operation before May next. The company is empowered to dredge, excavate and extract from lakes, rivers and streams.

Some Tips on Grinding Paper Mill Rolls

By H. J. Wills[1]

Paper mill rolls should be frequently reconditioned by grinding. Great skill and care is required to insure that they will be round and parallel—or if they are to be concave or convex, that the camber is as nearly perfect as possible. They must be free from chatter or traverse marks. Because of several conditions peculiar to the paper industry these qualities are not always easy to achieve. However, if certain points are observed, rolls can be kept in good condition at reasonable cost.

One of the Chief Difficulties

One of the difficulties is due to the fact that paper mill rolls are made of many different materials. For the theoretically best results, and greatest efficiency in grinding, each of the materials would call for a wheel of a different specification as to type and hardness of bond, grit size and the like. This would call for a large inventory of wheels and a great deal of time would be consumed in changing wheels. Because the majority of paper-mill rolls are made of chilled iron, it is common practice to select a wheel best suited to that type of roll, and to adapt it to other materials by proper manipulation.

Changes Which Secure Same Action

The great difference in the diameter of paper-mill rolls also affects the performance of a wheel. Large diameter rolls can be ground with wheels of softer grade than small rolls. A given wheel will act much softer when grinding a small roll than when grinding a large one. However, by making one or more of the following changes in operation, practically the same action can be secured: 1—increase the wheel speed. 2—decrease the work speed, 3—decrease the traverse rate, 4—use a lighter feed.

Of course, when changing from a small diameter roll to a larger, using the same wheel, the process would be reversed. Also, as the diameter of the wheel becomes smaller, through wear the rpm. of the wheel must be increased, or the rpm. of the work decreases. Because paper-mill rolls are comparatively long in proportion to the diameter they tend to vibrate, which is disastrous. Therefore it is necessary to keep the work speeds fairly low. There is also a tendency for the rolls to sag in the grinding machine. Roll vibration will result in chatter marks and in roll whipping. Whipping will cause the rolls to become oval shaped.

[1] Engineer, the Carborundum Co.

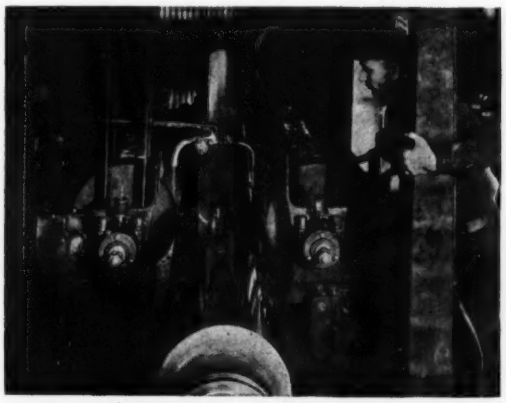
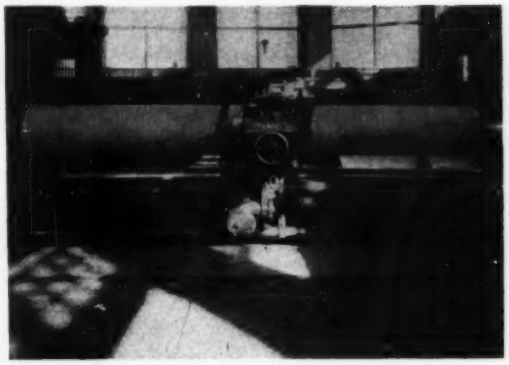


FIG. 1.
Chilled Iron Calender Roll, 9 Inches Diameter × 108 inches Long, Being Ground with Silicon Carbide, 60 Grit, Shellac Bonded Wheel. Time for Grinding 3¾ Hours.



Courtesy, Stowe-Woodward, Inc.
FIG. 2.
Stonite Top Press Roll 28¾ Inches Diameter × 241 inches Long, Being Ground with Silicon Carbide, 36 Grit, Resinoil Bond Wheel.

Preventing Sag and Vibration

To prevent sag and vibration the rolls should be supported by either two-point or three-point neck-rests. Experience shows that the two-point support is less apt to chatter, due to the fact that it is difficult to get even distribution of the load on three points.

Rolls tend to creep while being ground, which is fatal to good grinding since when a roll creeps it assumes different axes of rotation. Creeping can be avoided in two ways: by using a hold-down clamp on the top of the roll; and by making certain that the lubrication of the rests is not only adequate but even. Variation in the friction between roll and support will cause creeping. Because machines for grinding paper-mill rolls are built to handle rolls of comparatively small cross-sections without vibration or whipping, they present several difficulties, which can, however, be overcome with care.

For one thing, the grinding machines are of the two-wheel type with no provision for truing or dressing the wheels. This makes it necessary to use soft, self-dressing wheels which are not best suited to give long life and fine finish. The driving motors of these machines are mounted on a frame above the wheel. If flat belts are used they must be under considerable tension which, in itself may cause vibration. Unless the motors themselves are in perfect dynamic balance they will vibrate and the vibration will be transmitted to the wheel.

Shellac Bonded Wheels Widely Used

Because shellac bonded wheels tend to absorb vibration, they are widely used, although wheels of

resinoid bond are in many respects preferable. Resinoid wheels are not affected by age, and they give a faster cut and satisfactory surface qualities on the roll. In one paper mill which changed from shellac to resinoid wheels for grinding rolls, chilled iron rolls are now ground in six to eight hours as against 48 to 60 with shellac wheels. For best results with resinoid wheels it is necessary to increase the work speed about 30 per cent above that used with shellac wheels.

Because resinoid wheels do not absorb vibration as well as shellac wheels it is necessary to reconstruct the grinding machine somewhat if the type of wheel is to be changed. For instance, the flat belts should be replaced by v-belts.

To secure rigidity of the running parts of the roll grinder it is desirable to lap the bearings in to the spindles. After the spindles are aligned they are driven, during the lapping operation, either by hand or by power, using a very light belt only sufficiently taut to turn the spindle.

Applying Lapping Compound

Lapping compound can be applied to the surfaces through the oil holes, or directly to the surfaces before assembly. After the lapping compound is applied, adjust the bearings so that only a slight drag is felt when the spindle is turned by hand. Too much pressure may crush the abrasive crystals. The procedure is as follows:

1—Apply a special 400 grit aluminum oxide, grease lapping compound, and rotate the spindle with some oscillation for several minutes. Then examine the surface.

2—If more lapping is needed add more compound and continue, adding machine oil to the surfaces, until the surfaces are dark gray over the entire bearing area. Adjust frequently so that a slight drag will be maintained.

3—Clean all compound from surfaces and recesses.

4—Repeat operations 1 and 2 with the same type of compound except that the grit should be 800. Keep this up until the surfaces are light gray.

5—Continue without adding further compound. Keep adding machine oil in increasing quantities until practically all of the compound has been eliminated from the bearings. Make final adjustment to a light drag and run the spindle for five or ten minutes with oil only.

6—Clean all parts thoroughly and reassemble. The bearing is now ready for service.

Common Faults of Paper-Mill Rolls

Fish-tails and scratches are common faults of paper-mill rolls. These are usually caused by dirt in the coolant. Few of the grinding machines used in paper-mills are equipped with efficient coolant filtering systems. It will usually pay to install proper filtering devices.

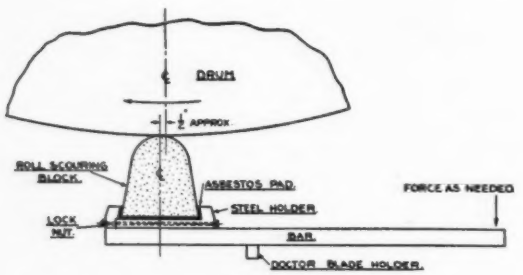


FIG. 3.
Smoothing Yankee Drier, or Couch Roll, Without Removing from Machine, with a Silicon Carbide Roll Scouring Block.

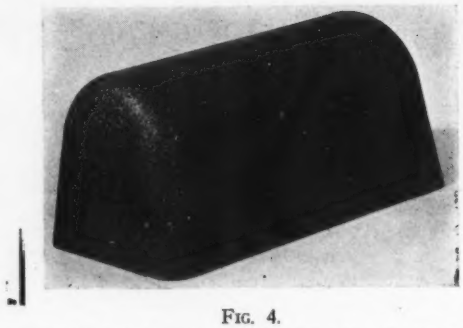


FIG. 4.
Silicon Carbide Roll Scouring Block for Refinishing Yankee Drier and Couch Rolls.

Water is the best coolant when grinding rolls. If there is danger of rusting, add one pound of sal soda to 50 gallons of water. Never use the heavy soluble oils. When dry grinding compressed paper and cotton rolls the wheel and the roll must be absolutely dry, otherwise the wheel will fill up quickly.

In grinding "stonite" rolls the wheels should run at about 4500 surface feet per minute. The work should revolve at 100 to 125 surface feet per minute. For roughing, the traverse should be about 28 feet per minute and for finishing 11 feet per minute. Roughing cuts should be not over .005 inch and finishing cuts not more than .002 inch. The operations should be done dry and the wheels slightly rounded at the corners.

Make-Shift Arrangements

For refinishing Yankee driers and couch rolls many make-shift arrangements are resorted to because it is impossible to swing the drier in the grinding machine. The best procedure, if the drums are in bad condition, is to smooth the surface without removing the drum from the machine. This is done with a silicon carbide roll scouring block of the shape shown in the illustration. For heavy stock removal grade 80-E is used. For less stock removal use grade 150-E. The block is mounted on a stick using the doctor blade holder, or other means, as a fulcrum. The operation may be performed wet or dry, and hot or cold.

If a higher finish than that supplied by the block is required, a whitewood lap is substituted for the rub. The surface is moistened with a compound of 320 grit aluminum oxide abrasive in soluble oil.

The inside surfaces of couch rolls must sometimes be refinished due to grooves being worn in the surfaces by the vacuum box wipers. Here, too, the grinding machine is of no use. Replace the wiper blades which are held in grooves in the vacuum box with a series of abrasive sticks, sufficient to fill up the entire length of the grooves. The spring under the vacuum box is used to press the sticks to the surface and the roll is turned with its own driving mechanism until the ridges are removed. It is well to rearrange the sticks occasionally so that they will not themselves be badly grooved. Because soft rubber rolls generate considerable heat when being ground, and tend to load the wheel the grinding operation is

somewhat different from that used for grinding metal rolls.

Proper Dressing

Proper dresing will eliminate loading to a great extent. It should be done with a sharp star dresser or diamond tool. It is also advisable to clean the face of the wheel frequently with a stiff wire brush. Sharp wheel edges are essential. Resinoid wheels are best because they do not load easily and dissipate heat readily. They can be operated at from 7500 to 9500 surface feet per minute. The work speed should be low, depending upon other conditions. The edges of the wheels should not be beveled.

Some Cooling Method Must Be Used

Most grinding of soft rubber rolls is done dry. Because of the tendency to heat unduly some cooling method must be used. This can be accomplished by means of a fan or blower which directs a strong stream of air against a large portion of the wheel and roll. Or, cooling may be effected by suction. The nozzle of a portable vacuum cleaner may be placed directly under the point of contact between wheel and roll. The two methods—blower and suction—can be used together with excellent results.

If neither method can be used, self-ventilation may be resorted to. A wide faced wheel is dressed so that the face is U-shaped. Thus a two-inch face wheel would be dressed so that at each side there is a face of one half inch width, with a half inch deep channel one inch wide between them. This creates a down draft between wheel and work.

If possible, it is best to grind soft rubber rolls wet as wheels are less apt to load, there is no cooling problem, and a better surface is secured. Plain water is best. The wheel edges should be kept sharp, heavy cuts avoided and slow traverse used. For finishing the roll should be driven as rapidly as possible without causing vibration or whipping and smoothed with 50 grit aluminum oxide coated cloth and then polished with 150 grit cloth. The roll should be well covered with powdered soapstone.

Hard rubber rolls are generally handled as a conventional roll grinding job except that they are generally finished with coated cloth in the same way as soft rubber rolls. Coolants must be thoroughly filtered. The wheels should be dressed with a sharp diamond and the edges of the wheel kept sharp.

Ohio TAPPI to Meet

The Ohio Section of the Technical Association of the Pulp and Paper Industry will hold a dinner meeting at the Hotel Manchester, Middletown, Ohio, Thursday evening, January 11, 1940. This will be the annual meeting for election of officers. The program for the evening will be sponsored by Wallace and Tiernan Company, Newark, N. J. A paper entitled "Chlorination Practice in Paper Mills" will be read.

Truck Drivers May Strike in Boston

[FROM OUR REGULAR CORRESPONDENT]

BOSTON, Mass., January 2, 1940—The year-end week for some in the paper and box board trade was not so quiet as usual, with inventory taking under way, for in a number of cases, members of the industry were busy with orders for immediate delivery, on account of the possibility of a truck-drivers' strike.

D. C. Everest Collects for Finland

D. C. Everest, president of the American Paper and Pulp Association has sent out the following announcement: "We of the paper and pulp industry have more than a sentimental interest in the fate of Finland. Through our contacts with Finnish manufacturers, upon whom we have depended for a substantial proportion of our wood pulp supply, we have learned to know Finland and the remarkable development which the Finnish people have made since their independence.

"I have accepted the chairmanship of an Industry Committee set up for the purpose of collecting funds to be sent to Finland through the Finnish Relief Fund, Inc. I am glad to accept this appointment and I know that the other members of the committee are equally glad to assist in raising funds. The committee personnel is as follows: Chairman—D. C. Everest, Marathon Paper Mills Company; R. C. Mateer, Scott Paper Company; G. W. Sisson, Jr., Racquette River Paper Company; J. L. Riegel, Riegel Paper Corporation; R. B. Wolf, Pulp Division, Weyerhaeuser Timber Company.

"Among the plans which have been considered for raising funds three seem to have the most merit. 1. Solicitation of direct company contributions. 2. Solicitation of personal contributions from company executives and administrative officers. 3. The collection in small amounts from mill and office employees.

"On behalf of the committee, may I ask that your company make arrangements for contributing to this fund on these three fronts? Because of the urgency of the situation, may I ask that you give this matter your immediate attention and set up within your company whatever procedure you feel will be the most effective.

"The Finnish Relief Fund, Inc., suggests that all funds be forwarded to the American Paper and Pulp Association in checks made payable to the Finnish Relief Fund, Inc. As substantial amounts are received, the checks will be delivered to the Finnish Relief Fund, Inc.

"As you know, Herbert Hoover is chairman of the Finnish Relief Fund, Inc., and is giving his personal attention to this activity. Edgar Rickard, president, Pejepscot Paper Company, is assisting Mr. Hoover in every way possible. Our committee will work directly with Mr. Rickard.

"The United States Treasury ruled, on December 15, that contributions by individuals to the Finnish relief fund may be deducted for income tax purposes, provided that, together with other charitable contributions, they do not exceed fifteen per cent of the taxpayer's net income. The Treasury also ruled that corporations may deduct contributions to the Finnish relief fund provided such gfts, together with other contributions, do not exceed five per cent of the corporation's net income. On behalf of the committee I want to urge every one in the industry to participate in this activity. We know the industry will do its part."

Nolan, Bowmall & Co. at 250 Park Ave.

Nolan, Bowmall & Co., whose address was incorrectly given in a recent issue as 230 Park avenue, New York, are at 250 Park avenue.

Government Paper Bids and Awards

WASHINGTON, D. C., Jan. 3, 1939—Marquette Paper Company will furnish the Government Printing Office with 41,900 pounds (299,000 sheets) of various size white sulphite ledger paper at 5.7 cents. Mudge Paper Company will furnish 10,000 pounds (50,000 sheets) of 22½ x 28½" jute tag board at 8.05 cents. Mathers-Lamm Paper Company will furnish 1,440 pounds of 21 x 32" white tissue paper at 11.55 cents. Aetna Paper Company will furnish 17,250 pounds (150,000 sheets) of 50% rag, 21 x 32" white ledger paper at 9.23 cents. Bids for all of these items were received on December 13.

Virginia Paper Company will furnish 100,000 sheets of 22 x 34" white gummed paper at $9.85 M sheets and National Pulp and Paper Company will furnish 40,000 pounds of newsprint paper in 24" rolls; 120,000 pounds same in 36" rolls and 200,000 pounds same in 48" rolls, all at 2.5 cents. Bids for these items were received on December 11.

Stanford Paper Company will furnish 71,755 pounds (500,000 sheets) of 32 x 42" white sulphite bond paper at 5.67 cents; Mathers-Lamm Paper Company will furnish 25,000 pounds (9,000 sheets) of 25 x 30" binder's board, hard rolled No. 1 at 3.66 cents; and R. P. Andrews Paper Company will furnish 44,400 pounds (150,000 sheets) of 24 x 38" H.F. sulphite manila tag board at 5.45 cents. Bids for these items were received on December 8.

Barton, Duer & Koch Company will furnish 40,000 pounds of yellow sulphite writing paper in 32" rolls at 5.48 cents, bids for which were received on December 6.

Whitaker Paper Company will furnish 28,000 pounds (100,000 sheets) of 22½ x 28½" jute tag board at 8.06 cents bids for which were received on December 4.

Mudge Paper Company will furnish 5,042 pounds 50% rag, 25 x 40¼" blue ledger paper at 9.52 cents and the same firm will also furnish 10,000 pounds same 21 x 32½" at the same price. Bids were received on December 1.

Mathers-Lamm Paper Company will furnish 2,000 sheets 20 x 24" glazed paper, red on one side at $6.25 per ream and Mudge Paper Company will furnish 1,680 sheets of 20 x 25" green gummed paper at $10.90 per M sheets. Bids for these items were received on November 27.

Mudge Paper Company will furnish 8,025 pounds of 50% rag, 21 x 32½" blue ledger paper at 9.52 cents and Marquette Paper Company will furnish 61,904 pounds of 50% rag, 22 x 34" white index paper at 7.96 cents.

Paper Bids

The Printing Office has received the following bids for 39,008 pounds (172,600 sheets) of 50% rag, 24 x 40" rag ledger paper; Aetna Paper Company, 9.44 cents; Mudge Paper Company, 9.21 cents; Barton, Duer & Koch Paper Company, 9.46 cents; R. P. Andrews Paper Company, 9.43 cents; Old Dominion Paper Company, 10.624 cents; Stanford Paper Company, 10.03 cents; Perkins-Goodwin Company, 11.69 cents, and Mathers-Lamm Paper Company, 10.1 cents.

For 51,000 pounds (500,000 sheets) of 28 x 34" white sulphite bond paper; Barton, Duer & Koch Paper Company, 5.66 cents; Mudge Paper Company, 5.73 cents; R. P. Andrews Paper Company, 5.93 cents; Marquette Paper Company, 5.63 cents; Old Dominion Paper Company, 6.14 cents; Perkins-Goodwin Company, 6.35 cents.

For 10,000 pounds (50 rolls) of oiled manila tympan paper; Link Paper Company, 7.5 cents; Mudge Paper Company, 7.96 cents; Cromwell Paper Company, 7.75 cents; R. P. Andrews Paper Company, 7.7 cents; Mathers-Lamm Paper Company, 7.75 cents.

For 53,120 pounds of buff bristol in 18" rolls; Old Dominion Paper Company, 4.089 cents; and Paper Corp. of U. S., 4.165 cents.

Hold Up Wood Pulp Report

[FROM OUR REGULAR CORRESPONDENT]

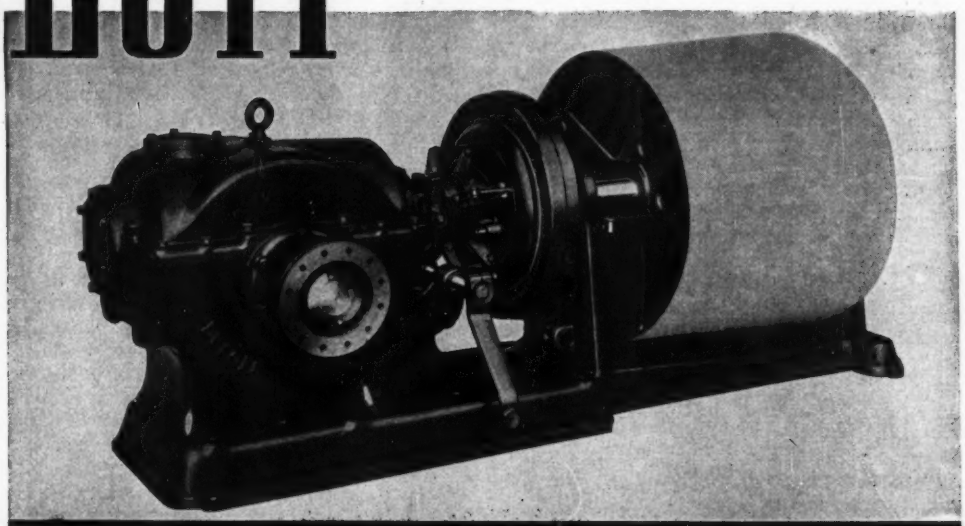
WASHINGTON, D. C., January 3, 1940—The United States Tariff Commission in its annual report made public this week makes brief mention of the wood pulp and pulp-wood resolution passed at the last session of Congress. In this connection the Commission says:

"On August 1, 1939, the Senate passed Resolution No. 160 directing the Commission to investigate and report to the Senate by April 15, 1940, on the conditions, causes, and effects of competition between wood pulp or pulpwood produced in the United States and that imported in the principal markets of the United States.

"Upon receipt of the resolution the Commission instituted an investigation designed to bring to date the information contained in a comprehensive report on wood pulp and pulpwood submitted to the Senate in 1937. Preliminary inquiry indicated that the more conspicuous changes that had occurred since 1937 were the decline in United States exports to Japan, substantial additions to the pulp-producing capacity in this country, a marked decline in pulp prices and generally depressed conditions in the domestic industry. Before the work was far advanced, conditions in Europe led to disturbances of shipping from Sweden, Norway, Finland, and other European countries. In recent years these countries have been supplying over two-thirds of the total imports of wood pulp into the United States. Freight and insurance charges on shipments from Europe sharply increased, placement of orders for future delivery were hampered, and the prices of domestic pulp tended to rise. Whether the conditions of the moment will continue, be moderated, or be intensified cannot be foreseen. In any event, the conditions which prevailed at the time the resolution was introduced have ceased to exist and it seems unlikely that they will again arise as long as the present conditions in Europe continue.

"In view of these circumstances the Commission has advised the Senate that, unless the Senate gives instructions to the contrary, completion of the report on wood pulp and pulpwood will not proceed for the time being, but that the Commission will keep advised on current conditions and will report them if at any time the situation seems to warrant such action."

BELOIT



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Southern Kraft Production Rises

The International Paper Company announced on December 28, that production of its subsidiary, the Southern Kraft Corporation, largest producer of kraft container board in the world, will reach an all-time record production during the last quarter of 1939 by producing approximately 171,000 tons of container board. The bulk of its capacity of this product is located at its Panama City, Georgetown and Springhill mills which have a present average capacity of 1,700 tons per day or 569,000 tons per annum.

Up to September 1939, demand for this product was only sufficient to permit these mills to run at an average rate of less than 75% of capacity but the heavy demand which began in that month has run these mills at capacity since that time.

Southern Kraft Corporation has always maintained standby capacity to meet peak periods of demand. In the last quarter it started operations at its Bastrop, La., mill and its York, Pa., mill thus increasing its capacity by 250 tons per day or 83,750 tons per annum. It still has mills with a capacity of 155,775 tons per annum, which have not yet resumed operations but which may do so if conditions justify this course during the coming year.

In addition to this standby capacity, Southern Kraft Corporation has begun improvements at its Georgetown and Springhill mills to cost over $650,000, which will make available an additional capacity of 330 tons of container board per day, or 110,550 tons per annum. This additional capacity will be in operation by April 1, 1940.

Thus, by April 1, 1940, Southern Kraft Corporation will have 330 tons of container board per day, or 110,550 tons per annum. This additional capacity will be in operation by April 1, 1940.

Thus, by April 1, 1940, Southern Kraft Corporation will have a container board manufacturing capacity of over 1,000,000 tons per annum as against an actual board production of about 510,000 tons in the year 1939.

Opens Sulphite Mill at Fernandina

Rayonier, Inc., announces the opening of its mill early this week for the production of bleached sulphite pulp at Fernandina, Fla. For the first time in the history of the wood pulp industry, the announcement adds, bleached sulphite pulp in commercial quantities is being manufactured from Southern pine. Rayonier developed the process used in its research laboratories and spent about $8,000,000 in establishing the new mill, acquiring the site and surrounding timber lands. Under full operation the plant will have an annual capacity of 64,000 tons, increasing the company's total output to more than 300,000 tons.

Chile To Make More Wood Pulp

Chile's dependence upon the import of pulp for paper manufacture has engaged the attention of private and government interests for some years past. There is at present only one company manufacturing mechanical pulp in Chile. No chemical pulp is manufactured in Chile although there is at present under construction a factory at Valdivia which hopes to begin production in the near future.

N. P. T. A. Convention Exhibit

The National Paper Trade Association, from its New York office, is again announcing to manufacturers the Exhibit of Wrapping Papers, Paper Products and kindred lines to be held at the Waldorf, New York City, in connection with the Association's 37th Annual Convention, February 19-22. These exhibits have become a permanent convention feature, meeting a recognized need of both manufacturers and merchants for a centralized place of meeting and an opportunity to display products distributed through merchants including new lines.

The following announcement in part has been sent to manufacturers who are invited to exhibit: "The entire 9th floor of the hotel has been assigned to us under arrangements that have proved so successful heretofore. Because, however, of a greater demand for suites of two or more rooms than are provided on this floor, we have also reserved additional suites in the East or Lexington avenue wing of the 8th floor below which is accessible by stairs. These suites correspond identically with those shown on the accompanying diagram and are correspondingly priced.

"At our urgent request the hotel management have modified last year's requirements by allowing exhibitors a four day rate from Sunday morning, February 18th, until 8 P.M. Thursday evening, February 22—in other words charging only for the number of nights of occupancy. This represents a reduction from last year of one day's charge at the rate quoted. Space may be reserved by making use of the enclosed application blank in connection with which please note the procedure outlined in paragraph 3 of the regulations. First, second and third choices should be indicated in sending us your application which should reach us on or before January 25 in order to participate in the usual drawing under which rooms will be assigned by lot according to the choices indicated.

"In view of the growing interest in these exhibits and the good results enjoyed, we anticipate this year the largest number of participants that we have ever had. Your presence will be appreciated by our members and we hope to receive your application by early mail."

Hooper Employees Given Party

PHILADELPHIA, Pa., January 2, 1940—The employees of Hooper Paper and Twine Company were the guests of President George K. Hooper in the company's headquarters at a Yuletide party which will long be remembered by those present. A very enjoyable program was presented by professional talent, and during the exchange of gifts, James Stewart, one of the salesmen who is soloist in the Church of St. Luke and The Epiphany, led the employees in the singing of Christmas carols.

Japan Fixes Waste Paper Prices

WASHINGTON, D. C., December 26, 1939—A notice of the Ministry of Commerce and Industry published in the Japanese Official Gazette establishes standard prices for waste paper, according to a report from the office of the American Commercial Attache, Tokyo. Prices ranged from 37 sen to 90 sen per kwan for waste foreign style, colored and Japanese paper and 13 sen to 20 sen for waste newsprint.

FINANCIAL NEWS

New York Stock Exchange

High, Low and Last for the Week Ending January 3, 1940

	High	Low	Last
A. P. W.	4	3⅝	3⅞
Armstrong Cork Co.	39¾	36½	39½
Celotex Corp.	11⅛	9¾	11
Celotex Corp., pf.	61	61	61
Certain-Teed Products Corp.	7⅛	6¼	7⅛
Certain-Teed Products Corp., pf.	32¼	29¼	31¼
Champion Paper & Fibre Co.	26¾	24¾	26⅝
Champion Paper & Fibre Co., pf.	104	103	104
Congoleum-Nairn Co.	24	22¾	24
Container Corp. of America	17⅛	16⅛	17
Continental-Diamond Fibre Co.	7¼	7	7¼
Crown-Zellerbach Co.	17¼	16¾	17¼
Crown-Zellerbach Co., pf.	91½	89½	90½
Flintkote Co.	21	19½	20⅝
Robert Gair	3⅞	3½	3¾
Robert Gair, pf.	17⅛	14¾	16¾
International Paper & Power	14⅜	13½	14⅛
International Paper & Power, pf.	57¾	54	57⅛
Johns-Manville Corp.	77¼	72	77¼
Johns-Manville Corp., pf.	130	128	128
Kimberly Clark Corp.	39	37	39
MacAndrews & Forbes	35	33½	35
Masonite Corp.	39½	36¾	39
Mead Corp.	11½	10¾	11¼
Paraffine Companies, Inc.	41¾	40½	40½
Rayonier, Inc.	19¼	17¼	19
Rayonier, Inc., pf.	28¾	28¼	28¾
Ruberoid Co.	19⅞	17½	19⅝
Scott Paper Co.	48⅜	48	48⅛
Scott Paper Co., pf.	114	114	114
Sutherland Paper Co.	29¾	29	29¾
Union Bag & Paper Corp.	14½	12⅜	14⅜
United Paperboard Co.	5½	4⅞	5½
U. S. Gypsum Co.	87½	83¼	87½
U. S. Gypsum Co., pf.	173½	172½	173½

New York Curb Exchange

High, Low and Last for the Week Ending January 3, 1940

	High	Low	Last
American Box Board Co.	7	6⅞	6⅞
Brown Co., pf.	28	27	27
Great Northern Paper	44¾	44	44¾
St. Regis Paper Co.	3⅜	2¾	3⅛
St. Regis Paper Co., pf.	60⅛	55½	59⅜
Taggart Corp.	6	5¾	5⅞

Great Lakes Votes $1 Dividend

[FROM OUR REGULAR CORRESPONDENT]

TORONTO, Ont., January 2, 1940—The directors of the Great Lakes Paper Company, Limited, Fort William, Ont., have, in view of the improved conditions in the newsprint market and the growing sales and profits of the company since the hostilities in Europe began, declared a dividend of one dollar per share on the 100,000 shares of Class A and 100,000 shares of Class B, no par value preferred stocks. The payment will be made at once. There is wide interest in this dividend in view of the distribution of the shares in Canada and the United States and the fact that the company earned $1.23 a share on these stocks in 1937 and 67 cents in 1938 but so far has paid no dividends. In 1940 the company will recover its additional contract for 20,000 tons of newsprint per annum with the Milwaukee Journal which was lost to it in 1939 under pro rating agreement.

Western Tablet Earns $472,154

The Western Tablet and Stationery Corporation for the year to October 31, reported a net income of $472,154, equal after dividend requirements on 5 per cent preferred, to $2.25 a share on 134,854 common shares. This compares with $250,623, or 61 cents a common share, in the previous year.

Hoberg to Install Pulp Equipment

[FROM OUR REGULAR CORRESPONDENT]

GREEN BAY, Wis., January 2, 1940—Installation of groundwood equipment estimated to cost $45,000 has been announced by J. M. Conway, president and general manager of Hoberg Paper Mills, Inc. The work is already under way under the direction of E. E. Den Dooven, general superintendent, and is being done by company engineers and millwrights. Completion is expected by the middle of February.

This improvement is a culmination of the company's plans to make the mills self-contained and eliminate groundwood purchases on the open market. Two 27 by 60-inch stones are to be installed for four-pocket grinders and will be electrically driven by 1,350 H. P. motors.

Production with this equipment is estimated at 20 tons per day, using mostly spruce. The pulp will be pumped from the Division B plant to the paper mill, where large stock tanks are being erected. Part of the pulp will be lapped for wet machines. Screens, pumps and stock thickeners also are being installed to take care of the increased run of pulp.

West Virginia Nets $1,095,389

The West Virginia Pulp and Paper Company and subsidiaries, for the fiscal year ended October 31, reported a profit of $1,095,389 after charges and taxes, equal to 18 cents a share on 902,432 shares of common stock, against $260,353 in the preceding year.

Hummel-Ross Pays Dividend

The Hummel-Ross Fibre Corporation resumed dividend payments on the common stock with a declaration of 20 cents a share, payable December 30 to stock of record December 20. Previous payment was 20 cents a share made on December 15, 1937.

Dennison Earns $226,837

The Dennison Manufacturing Company and wholly owned subsidiaries reported for the ten months to October 31, of net profit $226,837, equal to $5.77 each on 39,289 shares of $100-par 8 per cent cumulative debenture stock.

Marathon Profit $592,475

The Marathon Paper Mills Company and subsidiaries for the year to October 31, reported a net income of $592,475, equal after preferred dividends to $2.61 each on 199,567 common shares, compared with $267,136, or 99 cents a common share, in the previous year.

Nashua Pays $2 Dividend

The Nashua Gummed & Coated Paper Company—paid $2 Dec. 23 to stockholders of record December 22. Previous payment was $1 on November 15.

CONSTRUCTION NEWS

Cheboygan, Mich.—The North American Pulp and Paper Corporation, manufacturer of book, bond and other paper stocks, has plans under way for new one-story addition, to be used primarily for storage and distribution. It is reported to cost over $40,000, with equipment. Erection contract will be awarded soon and work placed under way early in 1940. Harold Thompson, Mullett Lake, Mich., is architect.

Chicago, Ill.—The Super-Loc Box Corporation of America, 473 West Erie street, manufacturer of paper boxes and containers, has arranged for lease of space in building at 1046 West Fullerton avenue, totaling about 20,000 square feet of floor space, and will occupy for plant. Present factory will be removed to new location, where increased facilities will be provided.

Oswego, N. Y.—The Diamond Match Company, 30 Church street, New York, N. Y., manufacturer of book matches, etc., has approved plans for two new additions to plant, consisting of a main unit, 105 x 150 feet, and adjoining structure, about 45 x 100 feet, each one-story. First noted building will be equipped for general production, while latter structure will be used for roll paper storage and distributing service. Cost estimated over $75,000, including equipment. General erection contract has been awarded to the James Leck Company, 211 South Eleventh street, Minneapolis, Minn., and work is scheduled to begin at early date.

Kalamazoo, Mich.—The Kalamazoo Vegetable Parchment Company, Parchment, near Kalamazoo, manufacturer of waxed, greaseproof and other processed paper stocks, has work under way on two new one-story mill additions, previously referred to in these columns, and will push construction to completion early in 1940. New units are reported to cost over $80,000, with equipment. M. C. J. Billingham, Kalamazoo, is engineer and contractor.

Wisconsin Rapids, Wis.—The Consolidated Water Power and Paper Company, manufacturer of bond, book, wrapping and other paper, has approved plans for new one-story addition, to be used for expansion in raw material storage and distributing division. Work will be placed under way at once. No estimate of cost announced.

Weymouth, Mass.—The N. D. Clapp Company, 179 Broad street, recently organized with capital of $100,000, plans operation of a local plant for the manufacture of a line of paper products. Production is scheduled to begin soon. New company is headed by Nathaniel D. Clapp, president and treasurer.

Newark, N. J.—Schiffenhaus Brothers, 326 Riverside avenue, manufacturers of corrugated paper boxes and containers, have arranged for lease of portion of building at 36 Spring street, and will occupy for expansion. Equipment will be installed for specialty paperboard production, including mothproof wardrobe cases and kindred products. Present plant at first noted location, occupying a one-story building of about 50,000 square feet of floor space, will be continued in service as heretofore.

Brunswick, Ga.—The Brunswick Pulp and Paper Company, manufacturer of bleached sulphite fiber, will carry out expansion in a number of departments in connection with mill development program recently referred to in these columns. An addition will be built to the digester house and new equipment installed for enlarged output; mill equipment installation also will include a 75-ton capacity recovery unit, spiral heat exchanger, modernization and improvements in screen room, mechanical washing equipment and miscellaneous equipment. Power house at the mill will be improved, with installation of a new back-pressure turbine unit and accessory apparatus. Plant capacity will be increased from 150 to about 200 tons per day. Entire project will represent an investment of about $500,000 and will be completed next spring. Company is a joint interest of the Scott Paper Company, Chester, Pa., and the Mead Corporation, Chillicothe, Ohio.

Chicago, Ill.—The Eagle Paper Box Manufacturing Company, 2309 South Keeler avenue, manufacturer of stiff paper boxes and containers, has superstructure under way on new plant at Monitor and Bloomingdale avenues, totaling approximately 60,000 square feet of ground area, recently secured under lease, as previously noted in these columns. The new building, similarly, will be occupied under a long-term lease with the owner, the Phipps Industrial Land Trust, Inc., 39 South LaSalle street. It will be one and two-story and basement, 130 x 340 feet, and is estimated to cost approximately $100,000, with equipment. Completion is scheduled in March, when company will take possession, removing present plant to new location and increasing capacity. The Campbell-Lowrie-Lautermilch Company, 400 West Madison street, Chicago, has the general erection contract. C. F. Morrison, 134 North LaSalle street, is engineer.

Hawkesbury, Ont.—The Hawkesbury Pulp Recovery Company, Ltd., 3827 Old Orchard avenue, Montreal, Que., has plans under way for new pulp mill at Hawkesbury, to be one-story type, consisting of several units, estimated to cost close to $100,000. It is proposed to begin work early in 1940.

Toronto, Ont.—The Morgan Paper Company, 925½ Dufferin street, manufacturer of paper products, has plans in progress for new one-story plant on local site at Gladstone avenue and Van Horne street, recently acquired. It will be about 45 x 150 ft., and is estimated to cost in excess of $50,000, with equipment. Work is scheduled to be placed under way soon.

L'Anse aux Cousins, Que.—The Le Boutiller Company, Ltd., Gaspe, Que., has plans under way for new one-story mill at L'Anse aux Cousins for lumbering operations in connection with pulpwood supply. It will consist of sawmill and other production departments, and is estimated to cost close to $50,000, with equipment. H. Le Boutiller, first noted address, is general manager.

TAPPI and Graphic Arts Meeting

The annual meeting of the Technical Association of the Pulp and Paper Industry, which will be held at the Roosevelt Hotel, New York, February 19-22, 1940 will, as in past years, reflect the technical advancement of the industry. Each year one branch or another of the industry predominated in reporting progress. This year the coated and printing papers fall in that category. As a result, an unusually fine program has been built up which shows this progress:

MEETING OF TUESDAY, FEBRUARY 20

Coating Session—9:30 A.M., Frank W. Egan, chairman:

1. Laboratory Evaluation of Paper Coating Raw Materials by C. G. Landes.
2. Influence of Body Stock on Coating by Glenn Davidson.
3. Standard Casein by W. E. Stringer.
4. Evaluation of Coating Made With Various Pigments by A. J. Luth.
5. Comparison of Casein, Soya Bean Alpha Protein and Various Starches as Adhesives in the Calcium Carbonate Coating Field by A. J. Luth.
6. Pulp Colors and Their Use in the Art of Making Coated Paper by J. R. Grierly.

MEETING OF WEDNESDAY, FEBRUARY 21

Graphic Arts and Coating Session—9:30 A.M., John F. Halladay and F. W. Egan, Chairmen:

1. The Velo Cold Set Process of Printing and Its Relationship to Printing by F. G. Breyer.
2. The Hygroexpansivity of Paper by H. W. Bialkowsky.
3. Improvements in the Printing Properties of Newsprint by C. A. Sankey and D. G. O. Jones.
4. Product Planning in the Glazed and Fancy Paper Industry by G. B. Tallman.
5. The Psychophysics of Color by E. R. Laughlin and I. H. Godlove.
6. Methods of Designating Colors by D. B. Judd.

MEETING OF THURSDAY, FEBRUARY 22

Miscellaneous Papers Session 9:30 A.M., C. E. Curran, Chairman:

1. Prosize by B. W. Rowland and W. M. Bain.
2. Manufacture and Use of Methocell by F. C. Peterson.
3. Developments in Synthetic Resins and Resin Emulsions by F. J. Myers.
4. Plastics and Chemicals from Wood by R. M. Boehm.
5. The Flocculation and Dispersion of Papermaking Fibers by A. Erspamer.

Peninsular Gives Workers Bonus

The Peninsular Paper Company, Ypsilanti, Mich., in announcing a good year through cooperation of employes, issued a Christmas bonus amounting to $4.00 a month for each employe. During the past years the paper company, when possible, has issued a bonus, and this one is in keeping with their past policy. The total amount is nearly $6,000.

The company states that slightly over 72 per cent of employees received the full amount of $48.

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PAPER TRADE JOURNAL

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Henry J. Berger
EDITOR

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COMING EVENTS IN PAPER INDUSTRY

AMERICAN PAPER AND PULP ASSOCIATION, Sixty-third Annual Convention and meeting, Waldorf-Astoria Hotel, New York. February 19-22.

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY, Convention, Roosevelt Hotel, February 19-22.

SALESMEN'S ASSOCIATION OF THE PAPER INDUSTRY, Annual Meeting and Luncheon, Waldorf-Astoria Hotel, New York, Tuesday, February 20.

NATIONAL PAPER TRADE ASSOCIATION OF THE UNITED STATES, Convention, Waldorf-Astoria Hotel. New York. February 19-22.

NEW ENGLAND SECTION. Technical Association of the Pulp and Paper Industry—Third Friday of each month at the Roger Smith Hotel, Holyoke, Mass.

DELAWARE VALLEY SECTION. Technical Association of the Pulp and Paper Industry—Second Friday of each month at the Engineers Club, Philadelphia, Pa.

LAKE STATES SECTION. Technical Association of the Pulp and Paper Industry—Second Tuesday of each month at the Conway Hotel, Appleton, Wis.

KALAMAZOO VALLEY SECTION. Technical Association of the Pulp and Paper Industry—First Thursday of each month at the Park, American Hotel, Kalamazoo, Mich.

PROSPECTS FOR 1940 BRIGHT

The past year was good enough for the paper and pulp industry to make a new record. The total domestic production of all kinds of paper is conservatively estimated at 13,250,000 tons, which is a new all-time record. The year past has also been a record year for most major industries. This is indicated by the Federal Reserve Board index of production which was estimated at 128 at the close of 1939, compared with 125, the highest peak in 1929. The low point was in July 1932 when the index declined to 58, or 42 per cent below the 1923-1925 average of 100, which is the base used in the Federal Reserve index. Impressive as the industrial record last year has been, Government economists state that complete recovery will not be achieved until the index rises above 140.

The prospects for 1940 are generally considered bright. It is also generally expected that industrial production will decline early this year. This is viewed by some economists as necessary to effect readjustment of inventories after the heavy splurge in speculative buying in the final quarter of last year. If this slackening occurs, economists point out, it will prove highly beneficial and prevent a slump later in the year when excess inventories must be worked off, if production does not taper off early this year.

Although little relief from the present heavy tax burden can be expected by business in the near future, there appears to be a trend toward more equitable and sound taxation. The tax legislation in 1939 was of a corrective character and the statutes relating to internal revenue were recodified. Among the improvements effected is the privilege of carrying forward net operating losses sustained in the calendar year 1939, and thereafter, which permits carrying over such losses into the next two succeeding calendar or fiscal years. This privilege is not extended to personal holding companies, neither can it be applied to the calculation of adjusted net income subject to the surtax on improper accumulations of surplus. Other improvements, while important, are not of a nature to contribute anything to business expansion or recovery. In other words, the amendments made in 1939 were not basic changes and a revamping of the whole present taxation scheme is required to provide a more equitable and sound taxation plan.

A threat to business expansion is seen in some quarters in the O'Mahoney-Hobbs Bill, which imposes additional penalties for violation of the anti-trust laws. Of all the legislative proposals awaiting consideration at the coming session of Congress, which will convene on January 3, none appears to carry such serious potential threats to business recovery as a bill introduced by Senator O'Mahoney and Representative Hobbs at the last session, states the Guaranty Trust Company of New York in the current issue of *The Guaranty Survey*. "This bill would provide additional penalties for violation of the anti-trust laws, without making any changes in the provisions of the laws defining acts that constitute violations," states the *Survey*. "The subcommittee in charge of the bill was reported to have received inquiries from more than a thousand business men all over the country, indicating a desire to testify before any action was taken. In view of the probable necessity of extensive hearings, the subcommittee decided to suspend further deliberation on the bill until the next session. The measure, accordingly, remains before Congress for action at the session that begins on January 3.

"The disturbing aspect of the bill is not that it provides drastic penalties for violation of the law. Criminals and persons who violate penal statutes of the usual variety should be imprisoned, fined, or otherwise punished. In the case, however, of business practices with respect to which the prohibitions of the statutes have not been clearly defined, these drastic penalties would be visited upon corporations and individuals who had no means of knowing, until a court and jury had decided the question, whether a given act was or was not a violation of the anti-trust law. It is in this respect and for this reason that the proposed law is a matter of such grave concern to business and to business men.

"This bill, if enacted, would change the law by creating a presumption that any activity on the part of a corporation subsequently held to have violated any provision of the anti-trust laws was 'authorized and ordered' by each of the officers and directors who had knowledge of the activity, unless the officers and directors could produce evidence that

would convince a jury to the contrary. Officers or directors who 'authorized and ordered' the violation could be imprisoned up to one year and fined up to $5,000. The bill would also add certain forfeitures to the list of penalties for violation of some of the anti-trust laws. For officers and directors, the forfeiture would be twice the amount of salary, bonus, and other compensation received during the period of violation. In addition, the officers or directors could be enjoined either permanently or for a temporary period of at least 90 days from serving the corporation, from receiving any compensation from it, and from engaging in business in competition with it."

Thus the O'Mahoney-Hobbs Bill, like much of the New Deal philosophy and legislation is, unfortunately, severely punitive and threatening. Despite the fact that Senator O'Mahoney, chairman of the "Monopoly Committee" championed the objectives of "free enterprise," in an address delivered before the New York Board of Trade in New York City, this regulation of "economic freedom" recommended by him as a cure for the ills of business cannot be recommended as stimulating to business expansion and recovery. Industry and trade cannot be saddled with any such restrictions and continue to forge ahead as it has done during the past year. Less Government interference in business and more efficiency in Government is needed.

More Pulp from Australian Tree

Wood pulp for use in paper, guncotton, textiles and the many other things for which cellulose is used may be grown on "tree farms" of limited acreage in the warmer parts of the South, through the adoption of a fast-growing Australian tree, casuarina, according to Professor Donald D. Bodé of the University of Tampa chemistry department.

Casuarina trees will grow 35 feet high with nine-inch trunks in six years; 56 feet high with 17-inch trunks in twelve years. They will produce from four to six cords an acre a year, compared with one cord an acre a year for Southern jack pine. Moreover, a cord of casuarina wood is one-fourth heavier than a cord of jack pine.

The Florida Forestry Service estimates that to supply a 200-ton mill with slash pine, 120,000 acres under forest management are needed. The same mill would be supplied by a 24,000-acre tract of casuarina.

Professor Bodé states that in fairly large-scale experiments he has produced at least 90 per cent of alpha cellulose from casuarina pulp. Since ordinary commercial requirements for this purpose call for only 87 per cent, this would seem to be easily adequate.

The pulp has been found good for book paper filler, but not as yet for newsprint.

The tree can be grown on poor soil, down to the edge of salt water. It should therefore thrive on the Florida keys and in the southern part of the peninsula, as well as elsewhere along the Gulf coast. It is sometimes called Australian pine, but it is not pine.

Production Ratio Report

These statistics are based upon paper production reports to the American Paper and Pulp Association.

COMPARATIVE MONTHLY SUMMARIES[1]

Months	1939	1938	1937	1936	1935	1934
January	77.5%	63.9%	90.3%	76.1%	65.8%	.....
February	81.7%	68.7%	90.1%	77.9%	70.0%	.....
March	84.0%	69.6%	90.3%	76.0%	70.5%	.....
April	82.9%	68.3%	92.1%	82.3%	70.0%	.....
May	80.2%	69.0%	90.6%	81.6%	69.4%	.....
June	79.7%	66.0%	87.3%	80.7%	72.3%	.....
July	75.2%	72.0%	81.8%	77.3%	64.9%	.....
August	82.9%	77.2%	82.9%	81.5%	70.9%	.....
September	88.7%	76.3%	78.6%	80.5%	71.9%	58.2%
October	96.6%	82.5%	73.5%	87.6%	75.6%	64.7%
November	97.2%	79.6%	61.9%	88.0%	75.3%	61.7%
December	.....	74.4%	54.5%	85.9%	71.2%	59.6%
Year Average	.....	72.3%	80.6%	81.3%	70.5%	.....
First 51 weeks	85.0%	72.5%	81.3%	81.3%	70.8%	.....

COMPARATIVE WEEKLY SUMMARIES[1]

CURRENT WEEKS, 1939		CORRESPONDING WEEKS, 1938	
November 18	98.4%	November 19	81.6%
November 25	96.2%	November 26	74.4%
December 2	95.2%	December 3	78.8%
December 9	96.7%	December 10	77.6%
December 16	98.0%	December 17	81.3%
December 23	97.2%	December 24	75.9%

The following statistics show the number of mills reporting by ratio groups:

	Number of Mills Reporting—Current Weeks					
Ratio Limits	Nov. 18, 1939	Nov. 25, 1939	Dec. 2, 1939	Dec. 9, 1939	Dec. 16 1939	Dec. 23, 1939
0% to 50%	30	38	41	32	33	19
51% to 100%	276	265	257	261	229	120
Total Mills Reporting	306	303	298	293	262	139

PAPERBOARD OPERATING RATIOS

Per cents of operation based on "Inch-Hours" reported to the National Paperboard Association.

Year	Jan.	Feb.	Mar.	Apr.	May	June	July
1935	62%	68%	68%	63%	61%	66%	62%
1936	62%	67%	67%	70%	69%	70%	69%
1937	80%	86%	86%	88%	85%	77%	66%
1938	54%	60%	61%	57%	58%	56%	57%
1939	60%	67%	71%	69%	64%	67%	63%

Year	Aug.	Sept.	Oct.	Nov.	Dec.	Year Avg.
1935	67%	71%	77%	71%	61%	66%
1936	75%	78%	82%	80%	74%	72%
1937	74%	69%	65%	55%	45%	73%
1938	66%	66%	70%	65%	59%	61%
1939	72%	74%	84%	....	....	....

Week end. Nov. 18, 1939—83%
Week end. Nov. 25, 1939—78%
Week end. Dec. 2, 1939—78%
Week end. Dec. 9, 1939—79%
Week end. Dec. 16, 1939—79%
Week end. Dec. 23, 1939—81%

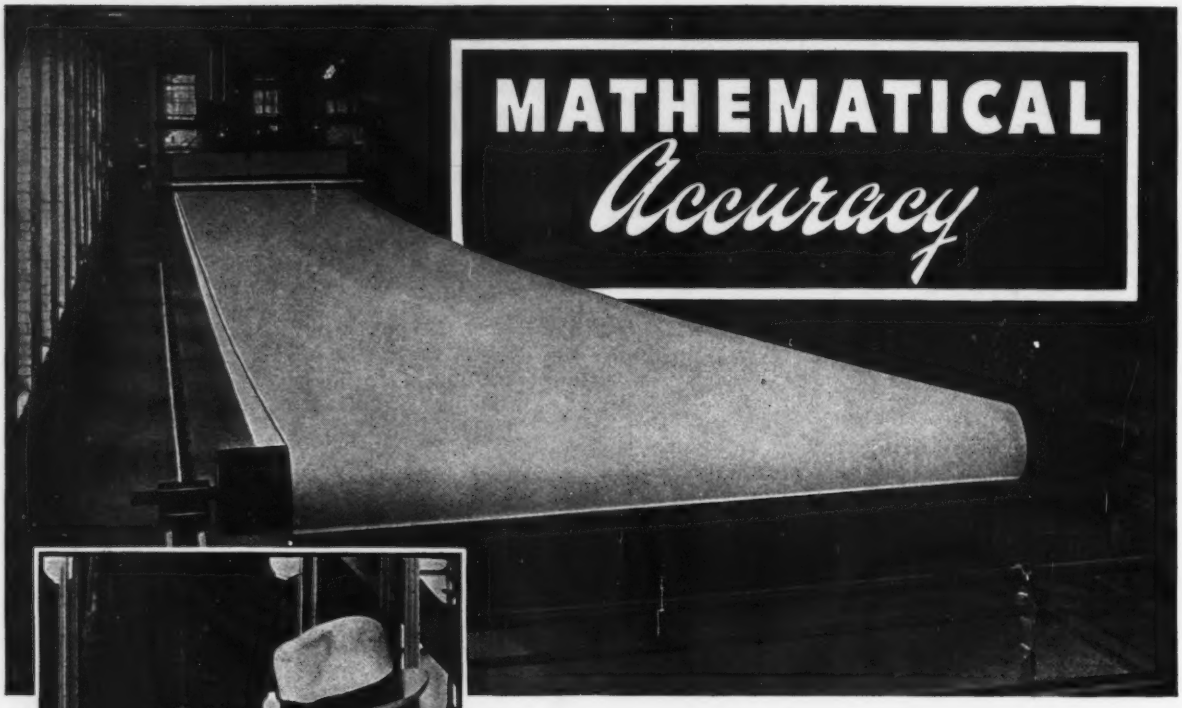
[1] Production-capacity ratios are based upon six-day capacity ratings which are adjusted periodically to correspond with the ratings reported by individual companies. Ratios are subject to revision until all reports are received.

Newsprint Scarce in India

[FROM OUR REGULAR CORRESPONDENT]

WASHINGTON, D. C., December 26, 1939—The Indian and Eastern Newspaper Society has notified its members that those newspapers using rotary presses should exercise strict economy in the use of paper, since all newsprint for their presses must be imported. Several are said to have reduced their size already, according to a report from the office of the American Trade Commissioner, Calcutta. Landed stocks of newsprint available to purchasers are small or non-existent, and this office has already had one inquiry from a newspaper in urgent need of supplies.

It is indicated that newspapers whose stocks of newsprint are exhausted might resort to Indian-made reeled paper, which is regarded as satisfactory for flat presses, but not suitable for use on fast rotary presses designed to utilize mechanical wood pulp papers.



Photo, Courtesy The Champion Paper & Fibre Co.

THE ROLLS, bearings and bushings of a paper machine must be mathematically accurate in order to maintain uniformity of output. Periodical regrinding of rolls and readjustment of bearings is necessary to correct uneven wear and faulty alignment.

The wear and tear on a woolen felt is much greater than that of the metal parts. It cannot be corrected by mechanical treatment. The felt must be uniform in thickness, weave and texture when it goes on the machine. It must wear evenly until it is worn out.

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Section of the
Technical Association of the Pulp and Paper Industry

Edited by Ronald G. Macdonald, Secretary

The Chemistry of Lignin

I. The Existence of a Chemical Bond Between Lignin and Cellulose

By A. J. Bailey[1]

Abstract

Commercial cellulose production from wood employs hydrolyzing liquors, yet the necessity of hydrolysis in dissolving lignin has never been proved or disproved. Digestion of aspen and jack pine wood in butanol-water mixtures, buffered to prevent hydrolysis, removed all of the lignin from aspen and 80 per cent of the lignin from jack pine. The remaining jack pine lignin was easily removed in the same solvent made 2 per cent in NaOH. The lignin fractions appeared to be similar or identical, the difference being that one was in chemical combination with cellulose, the other not combined. Yields under various conditions of digestion were determined, and changes in the wood caused by digestion were followed by determining the analytical constants of the residues from digestion. All tests indicated that lignin may exist partly in true chemical combination with cellulose and partly free, or entirely uncombined to cellulose, the determining factor being the species of wood.

All commercial processes which produce cellulose remove lignin from the raw material. The ease of removal, therefore, is of major interest to any cellulose-producing or cellulose-using industry. Intimately related to ease of removal is the state of physical and chemical association of lignin and cellulose. Although both of these substances have been known for over a century, no one has ever proved or disproved the existence of a chemical ligno-cellulose bond.

Terminology

Early nomenclature was not clear and was based on inadequate evidence, hence it is usually erroneous and wholly inadequate and misleading. Some early investigators used terms meaning, and intended to mean, an actual chemical combination with little more evidence of such a union than mutual occurrence in the same part of the plant. It was formerly common to speak of cuto-cellulose although no evidence for the existence of such a combination existed. Modern terminology still limps along with some of these inaccurate and ambiguous terms. As recently as eight years ago, cellulose was discussed under the groups: "the celluloses proper, the compound celluloses, and the hemicelluloses," while the compound celluloses were further defined as "the natural products in which the cellulose molecules are united to those of a different type and include ligno-celluloses, pecto-celluloses, muco-celluloses, adipo-celluloses, and cuto-celluloses" *(6)*. Admittedly, this is a clear-cut and definitive explanation, yet one having little or no foundation in experimental fact.

In later years, the trend of active chemical workers in the field has been away from the use of these terms so that in current research reports by chemists, these terms are less commonly seen, although the botanical literature does not yet generally reflect the release from the inaccuracy and ambiguity of such nomenclature. Much of the difficulty arises from in adequate information, different interpretations, and the difficulty of reproducing experimental work. Of necessity, only further research and time will bring order to this extremely controversial field.

In spite of a century of research, an attempt to define lignin emphasizes our ignorance of its fundamental nature. Lignin might be defined as a compound, either aliphatic, aromatic, or heterocyclic in nature, which has a morphologic but not crystalline arrangement, which has no fusion point, which has no known inert solvent, whose reactions are obscure, whose derivatives are unexplained, whose molecular weight is decidedly uncertain, and whose fundamental chemical structure is definitely unknown. One new school of thought even denies the existence of lignin in nature, claiming it arises from chemical treatment in isolation and hence is only "apparent."

Evidence and Theories of Ligno-cellulose

All commercial processes producing cellulose utilize a hydrolyzing liquor. It even appears questionable whether or not lignin has ever been removed without some hydrolytic action, since there appears to be no known inert solvent for lignin, while valid proof of truly neutral conditions during solution or isolation seems to be lacking. While no exhaustive discussion of the literature can be presented in a paper of this length, some of the theories and experiments are of significant and fundamental interest. In antipodal opposition to the concept of a true ligno-cellulose, Payen, one of the earliest investigators, in 1838, enunciated his theory "d'incrustations ligneuses" *(33)* putatively consisting of a less resistant, heterogeneous material which was mechanically "incrusted" in the tissue, an extremely unfortunate term which is still used occasionally today. Modern dictionaries agree that "incrust" means to cover with or as with a crust or hard coat, a meaning completely at variance

[1] Member TAPPI, formerly Assistant Professor of Forestry, University of Minnesota, St. Paul, Minn., now Acting Director of Lignin and Cellulose Research, Dept. of Chemistry and Chemical Engineering, University of Washington, Seattle, Wash.

with modern knowledge, and a term whose use should be discontinued. Payen's reasons for believing lignin and cellulose to exist in a mechanical mixture rather than in a chemical union are not clear, since no *a priori* reason existed, nor did his experimental work point to such a conclusion as his reagents were concentrated acids and alkalies and powerful oxidants. In spite of the lack of evidence, Payen's views were widely accepted by many chemists and biologists of the last century and the early part of the present century, seemingly either in preference for alignment with a dominant school of thought, or, on what now appear to be improbable conclusions. So strongly was the prejudice entrenched in the minds of some workers in favor of a mechanical relation that it was common to study "incrusting materials" with potassium chlorate and nitric acid *(40)* or chlorine dioxide *(39)* entirely neglecting hydrolytic or oxidative spitting from a carbohydrate.

Among the few early investigators who did not accept the incrustation theory were Fremy and his coworkers (1859) who gave no credence to a mechanical relationship, claiming that wood elements were composed of homogeneous chemical individuals which required specific chemical action in proximate analytical procedures *(14)*. Unfortunately, Fremy's views and methods were in general disrepute some decades before the close of the last century. In fairness to these early investigators, it should be recorded that the incrustation hypothesis stimulated research, that interpretations suffered from inadequate basic information, that most investigations made distinct and valuable contributions to fundamental knowledge, while some workers realized the limitations of method and admitted that the final answer must await the isolation of lignin in an unchanged condition, a goal which is not yet and perhaps never can be reached.

Impressed with the difficulty of removing noncarbohydrate material in purifying wood cellulose, Erdmann *(12)*, in 1866, was led to the formation of a new hypothesis. Parallel alkali fusion of wood and purified cellulose showed pyrocatechol to arise only from wood while other degradation products were common to both materials. Realizing the importance of his results, Erdmann hypothesized a complex molecule ("glycolignose") consisting of "lignose" to which was chemically bound a monosaccharide, cellulose, and the precursor of pyrocatechol. In defense of this concept Erdmann emphasized that the relative insolubility of wood in Schweitzer's reagent pointed to the probability of the absence of chemically free cellulose in wood. This theory led other investigators to approach the lignin-cellulose relationship from a less prejudiced angle with the result that new evidence was brought forth to substantiate the hypothesis. Lange, in 1889, *(26)* observing that alkaline digestion of wood yielded free hydroxyls (cellulose) and salts of an acid (lignin), became convinced that cellulose and lignin existed in the relationship of an ester, separable by simple hydrolysis, although another explanation has since been given to this evidence *(41)*. At about the same time and in subsequent years the ether linkage was proposed as the bond between lignin and cellulose by Hoppe-Seyler *(20)* and others, although Grafe later proposed to modify *(16)* this belief to include only part of the lignin which he believed to be a mixture of chiefly aromatic compounds, partly in ether-combination, partly held by the wood with a mesh-like resistance, and partly free, a belief in striking agreement with some data and opinions of today. In more recent years, Cross and Bevan supported the chemical compound theory, tacitly accepting the ether linkage and forcefully attacking the incrustation theory *(9)*. They designated the noncellulosic material as "lignone", and indicated the chemical combination of cellulose and lignin by "ligno-cellulose", apparently the first actual use of this term to denote definite combination. Further work appears to have made them less certain of their conviction since they later said that lignin "may or may not be in chemical combination" with cellulose *(10)*, while Cross and Doree retired even further from their earlier position (*ibid.* p. 152).

Another hypothesis, closely related to the true combination theory, was devised by Wislicenus *(43)* depending on the possibility of adsorption of lignin from the colloidal protoplasm onto the cellulose interface. While the inference is clear that lignification was primarily an adsorption phenomenon, this theory did not exclude true combination between lignin and cellulose from consideration. Also, it is apparent that Payen's incrustation theory can also be included in this general concept. While this theory has in the past received endorsement from critical workers, others have discredited it. Within recent years physiological and cytological evidence have appeared to make this theory distinctly unconvincing or completely untenable.

Still another approach to the problem has been made by the combination of microchemical and histological techniques. Many botanists used this method with splendid success a half century ago but it remained for König and Rump *(24)* to realize greater possibilities of the method. Since removal of one constituent of the cell wall did not cause physical disintegration, they concluded that lignin and cellulose could not be in true combination, and favored Sacchse's concept *(38)* of a solid solution. Recent work by several investigators has shown their conclusion to be entirely invalid. In particular may be mentioned the work of I. W. Bailey and Kerr *(5)* in their elucidation of the morphology of lignin and cellulose, occurring together in two interpenetrating systems as well as the familiar parallel: the denitration of cellulose nitrate filaments yielding a celluose skeleton identical with the original in physical form. Within a little more than the last decade, many investigators have brought the technique to a high stage of development with the simultaneous exposition of many new facts. Of distinct interest are the studies of Ritter *(34, 36)* who demonstrated middle lamella and cell wall lignin, which was verified and extended by Harlow *(19)*. Also bearing on the cellulose-lignin relationship is the examination of cell wall structure of wood by Ritter *(34, 36)* while a wide range of material has been investigated by I. W. Bailey and Kerr *(5, 21, 22)* including many species of wood and cotton, and greatly extending our knowledge of lignin and cellulose morphology. Inasmuch as the emphasis is primarily morphologic and as a splendid discussion is given in the original papers, a review of it here is unnecessary. In the same category are the reports of Lüdtke *(29)* who developed an extremely interesting hypothesis of a "Hautsystem" which he believed occurred between "Streifen" and fibrils as a noncellulosic skin or partition. Farr also believed in the existence of a separating layer around certain structural elements, which

she claimed had properties resembling some pectic-like material *(13)*. At about the same time, the author reported findings on the existence of a gel-forming substance between fibrils and lamellae which, however, appeared to be cellulosic, since it gave rise to phenylglucosazone *(3)*. A somewhat different picture was presented by Freudenberg *(15)* who believed that lignin, in the main, served as a matrix in which micelle series of cellulose were imbedded. It is probably true, however, that morphologic data can never completely answer the question of the existence of a ligno-cellulose, yet it is also true that information of this type contributes greatly to a clearer understanding of the intimate relation between lignin and cellulose.

Extensive work at McGill University with methanol, ethylene glycol, phenol, and alkali *(7, 8, 17, 23, 30)* indicated that H^+ or OH^- catalyzed lignin removal, while the question was not answered as to whether or not hydrolysis was essential to lignin removal. Similar results have been obtained with dioxane *(1, 11, 25, 32)*, ethyl aceto-acetate *(27)* and various alcohols *(18)*. Of particular interest is the work of Ross and Hill *(37)* who found that progressive extraction with dilute alkali left a residue in which a definite ratio of lignin to cellulose existed. Little thought, apparently, has ever been given to the possibility of a ligno-pentose or ligno-hexose. A recent communication *(31)* reports that lignin was removed by dilute alkali, which is usually regarded as a somewhat specific hemicellulose reagent. No claim was made for the existence of a definite lignohemicellulose bond although the possibility is an active one. Little can be deduced from these data which appear to be extremely difficult, if not impossible of interpretation at present.

The above résumé, of course, serves as emphatic and voluminous evidence that both the hands and imaginations of research workers have been hyperactive. Unfortunately, most of the work is invalidated, from the standpoint of ligno-cellulose, by the absence of truly neutral conditions or by the presence of reactants which would prohibit the detection of a chemical bond between lignin and cellulose. Many claims have been made that a supposed "solvent" failed to take out lignin, and on this basis, that a chemical bond with cellulose existed. In the author's opinion, however, the more logical conclusion is simply insolubility. Fractional removal of lignin means little since it remains to be proved that lignin is not a mixture of chemical individuals. Lignin removal is further complicated by the apparently complete absence of an inert solvent, as a condensation product appears to be the inevitable result of treatment with phenol, dioxane, etc. Lemmel has recently announced the solution of lignin at room temperature by ethyl aceto-acetate in the presence of hydrochloric acid, without reaction or decomposition *(27)*, yet, in the absence of positive proof, it appears highly improbable that a compound as reactive as ethyl aceto-acetate would function as an inert solvent when, by analogy, both aliphatic and aromatic solvents give rise to condensation products.

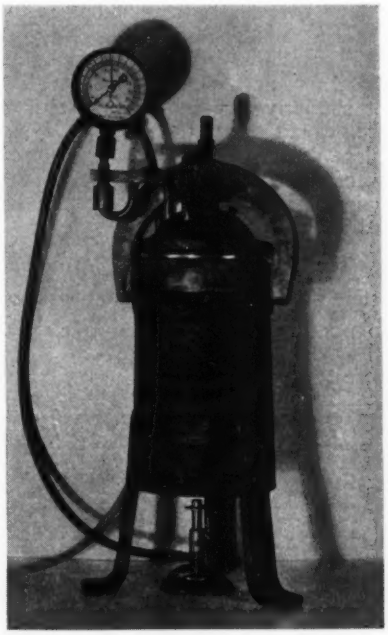

FIG. 1.
The Assembled Autoclave as Used in Digestion.

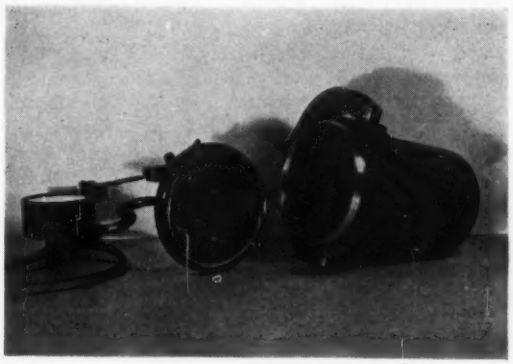

FIG. 2.
Autoclave Dismantled to Show the Interior.

Based on an extensive amount of experimental work, a communication from this Experiment Station was recently published by Aronovsky and Gortner *(2)* reporting a difference in the ease of pulping a hardwood and a softwood with butyl alcohol. Although they have not yet published all of their experimental data, from conversation and examination of the research notes, it seemed clearly apparent that they had uncovered information which appeared strongly to indicate the presence of a true chemical bond between lignin and cellulose. A report of these findings will be left to Aronovsky and Gortner. For the present report it will suffice to say that they removed lignin with ease from aspen wood with butyl alcohol while some of the lignin in jack pine resisted removal by similar treatment.

Details of Digestion

In order to study this relation, digestions were carried out on a mixture of sapwood and heartwood of aspen (*Populus tremuloides* Michaux) and on heartwood of jack pine (*Pinus Banksiana* Lambert). Before analysis all of the wood was reduced to sawdust and ground in a Wiley mill to pass through a 40-mesh screen. In every case, before digestion the wood flour was dried to constant weight at 105 deg. C. in order to make accurate determinations of yield possible. Reagents used were all c.p. or U.S.P. and in the case of recovered butyl alcohol, was freed from

aldehyde, made alkaline, and distilled. The digestion apparatus was a bronze autoclave of 2-l. capacity, heated with gas, which was controlled by a combination pressure gage and pressure gas regulator, and equipped with a thermometer well. The autoclave and control devices are shown in Fig. 1 and 2. All digestions were carried out at a temperature of 158 deg. C. (132 lb. per sq. in.) using, in general, equal volumes of butanol and water and in certain cooks other reagents as noted. The following digestion procedure, although not used in every cook, was typical. The wood flour was dried at 105 deg. C. to constant weight in an aluminum moisture box. Both wood and reagents were placed in the autoclave, and the cover bolted down upon the lower section which wedged a lead ring into a groove in the top. Bringing up to pressure was accomplished usually by two burners, the time required varying from 45 min. for 2000 cc. of liquid to 10 min. for 400 cc. of liquid. After reaching the required pressure, one burner was removed, the other controlling the temperature by means of the pressure regulator in the gas line, within probably ±1-3 deg. C. After holding at pressure for the required time, i.e., 4 hr. for a "4-hr. cook", the heating was discontinued, the time for cooling to room temperature varying from 45 min. for 2000 cc. of liquid to 30 min. for 400 cc. of liquid. In no case was vapor released to hasten cooling. When cool, the cover was removed and contents filtered on a Büchner funnel. The wood was washed several times with small quantities of water which were added to the filtrate, and the aggregate liquor set aside for analysis. The wood was then washed with water and reagents until suitable tests showed the complete absence of cooking reagents and degradation products, discarding the washings. The wood was removed quantitatively to an aluminum moisture box, dried at 105 deg. C. and the yields determined. The dried pulp was reduced to a uniform flour in a mortar and preserved for analysis.

Inasmuch as the present paper is concerned primarily with the existence of a ligno-cellulose bond, only that data will be presented here which pertains to that union. The composition of the final liquors, methods of analysis, reactions and products of lignin, etc., will be discussed in later papers.

Effects of Digestion

The experimental work of Aronovsky and Gortner was repeated, and the resistance of some jack pine lignin to solution was verified. In these preliminary cooks, wood flour plus equal volumes of purified butanol and distilled water were used. No attempt was made to maintain absolutely neutral conditions, and it was noted that a slight acidity developed, as Aronovsky and Gortner had already noted. One of the immediate objectives appeared to be the solution of the resistant lignin. The lignin removed was consequently studied by a number of classifying reactions and its behavior noted so that a general idea of its properties was established, enabling a prediction of behavior under new conditions. The knowledge of these properties, to be reported in a later paper, not only greatly simplified the experimental work, but also made it more positive and indicated the method of attack for the removal of the resistant lignin. While the exact nature of the linkage between lignin and cellulose was not completely established, it appeared to have the general characteristics of a glucoside linkage. For an analytical investigation, oxidative and acid hydrolytic splitting were useless. Alkaline hydrolysis, however, appeared feasible. After preliminary cooks had proved this possibility, an entire, new set of cooks was run on pine to study the resistant lignin. To prohibit hydrolysis in neutral cooks, cooking liquors were buffered by making 0.1 *N* in mono-sodium phosphate and 0.2 *N* in di-sodium phosphate. Since the ratio of these salt concentrations governs the *p*H, and since this ratio was practically the ratio of the concentration of the primary to the secondary phosphate ions or 1:2, the solution had a *p*H of 7 and was truly neutral. Buffer effects were only slightly reduced by the acids formed in cooking as considerable reserve was found in the final liquor after digestion. The only departure from neutrality, then, was due to the extremely small increase in ionization constant with temperature. In other words, for all practical and most theoretical purposes, the cooks were neutral. The yields agreed very closely with those from unbuffered cooks, showing hydrolysis to be negligible. It was found that about 20 per cent of the total lignin in pine resisted solution in neutral cooks, although the exact numerical boundary did not appear to be as sharply defined as could be desired. It is doubted if this lack of sharpness had a hidden significance since one would expect this condition as the rate of lignin solution slowed down while the rate of cellulose degradation was not similarly affected. The lack of sharpness, therefore, would appear to be caused by the rate of cellulose degradation rather than by an indefinite quantity of lignin. In striking contrast, 80 per cent of the pine lignin and all of the aspen lignin were dissolved in a neutral cook.

Hydrolysis of Ligno-Cellulose

Digestion of pine flour containing only the resistant

TABLE I.—COOKING, YIELD OF RESIDUE, AND DELIGNIFICATION DATA

Cook no.	Sample	Reagents	Time: To reach cooking temp.	Time: At cooking temp.	Time: To cool to room pressure	Residue after cooking: Basis of sample Per cent	Residue after cooking: Basis of original wood Per cent	Lignin in residue: Basis of residue Per cent	Lignin in residue: Basis of original wood Per cent	Lignin in residue: Per cent of original lignin left
9A	45 g. untreated aspen	2 liters neutral butanol and water 1:1.....	45 min.	4 hr.	45 min.	52.8	52.8	2.2	1.2	7.6
9B	15 g. residue from 9A	1 liter neutral butanol and water 1:1.....	25 min.	3 hr.	40 min.	92.4	48.7	1.1	0.5	3.2
8A	40 g. untreated pine	Same as 9A.....	45 min.	4 hr.	45 min.	47.8	47.8	15.1	7.2	27.4
8B	12 g. residue from 8A	Same as 9B.....	25 min.	3 hr.	40 min.	87.4	41.7	12.5	5.2	19.9
10	63 g. untreated pine	2 liters buffered butanol and water 1:1.....	45 min.	4 hr.	45 min.	47.5	47.5	15.2	7.2	27.4
11	20 g. residue from No. 10	1 liter buffered butanol and water 1:1.....	25 min.	3 hr.	40 min.	87.2	41.5	12.6	5.2	19.9
27	6 g. residue from No. 11	400 cc. butanol and water 1:1 plus 8g. NaOH	10 min.	15 min.	30 min.	60.4	25.1	10.2	2.6	9.9
26	"	"	10 min.	30 min.	30 min.	58.0	24.0	3.4	0.8	3.0
20	"	"	10 min.	1 hr.	30 min.	45.6	18.9	1.7	0.3	1.2
23	"	"	10 min.	2 hr.	30 min.	43.1	17.9	0.1	0.0	0.0

TABLE II.—CHANGES IN COMPOSITION OF LIGNO-CELLULOSE BY ALKALINE DEGRADATION

Cook no.	Time of alkaline cook, hr.	Lignin in residue after alkaline cook: On basis of residue, per cent	Lignin in residue after alkaline cook: Original lignin per cent	Alpha cellulose per cent	Cross and Bevan cellulose per cent	Pentosans per cent
11	0	12.6	19.9	70.3	82.3	0.0
27	¼	10.2	9.9	52.8	85.5	0.0
26	½	3.4	3.0	51.6	87.7	0.0
20	1	1.7	1.2	43.0	91.7	0.0
23	2	0.1	0.0	39.4	95.8	0.0

lignin (hereafter called *ligno-cellulose*) in equal parts of purified butanol and water, made up to 2 per cent in NaOH, resulted, after a 2-hr. cook, in a light pulp virtually free from lignin. The complete cooking data, yields, and lignin contents illustrating these points are shown in Table I. Lignin determinations were made by the method of Ritter and Barbour *(35)*. The original aspen wood had a lignin content of 15.8 per cent (the original sample contained sapwood) and the pine 26.2 per cent.

It will be noted that neutral digestion of aspen removed practically all of the aspen lignin and 80 per cent of the pine lignin, while the remaining 20 per cent, after splitting with alkali, was also dissolved. This would appear to be clear-cut evidence of a ligno-cellulose bond (pentosans were entirely absent from the ligno-cellulose). The more pertinent of these data are shown in Fig. 3.

Changes in Composition Caused by Hydrolysis

Of particular interest in studying ligno-cellulose were the changes in composition which it suffered during alkaline cooking. The first row in Table II shows the composition of the ligno-cellulose; the others show the effects of alkaline digestion. Cooks 27, 26, 20, and 23 were identical except as to time of digestion. Alpha cellulose was determined by the standard A. C. S. method, Cross and Bevan cellulose by the method of Sieber and Walter *(42)*, and pentosans by the method of Bailey *(4)*.

The changes in composition can be more easily followed by an inspection of Fig. 4 which is self-explanatory.

One feature is especially worth noting, namely, the breaks in the α cellulose and yield curves between ¼ and ½ hour. When the yield curve was first drawn, the irregularity was believed to be in error but the close similarity with the α-cellulose curve and the rechecking of experimental values proved it to be correct. Although the explanation is beyond the scope of this paper, such an occurrence would be predicted from earlier experimental work *(3)*. As other workers have reported data showing identical irregularities, and as an extremely difficult problem in animal fibers has recently been explained with signal success on a somewhat similar basis *(28)*, an attempt will be made to prove experimentally the validity of the explanation.

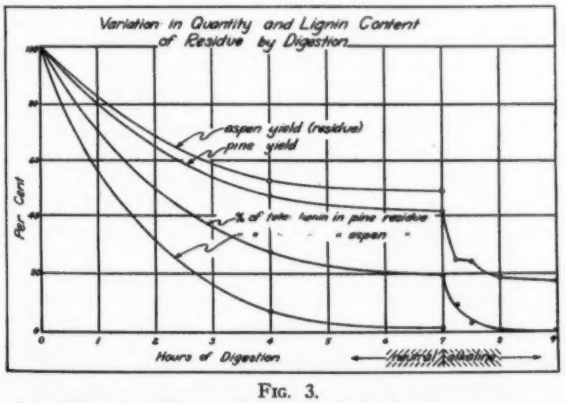
Variation in Quantity and Lignin Content of Residue by Digestion
aspen yield (residue)
pine yield
% of tot. lignin in pine residue
" " aspen "
Per Cent
Hours of Digestion

FIG. 3.
Curves Showing Yields and Lignin Contents with Increased Time of Digestion. All Data on the Left of the Seven Hour Ordinate are from Neutral Cooks; Those on the Right Are from Alkaline Cooks.

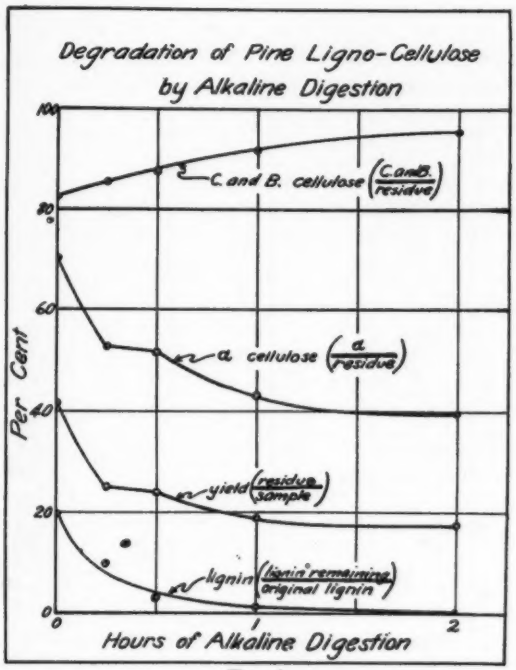
Degradation of Pine Ligno-Cellulose by Alkaline Digestion
C. and B. cellulose (C. and B. / residue)
α cellulose (α / residue)
yield (residue / sample)
lignin (lignin remaining / original lignin)
Per Cent
Hours of Alkaline Digestion

FIG. 4.
Curves Showing the Change in Composition of Ligno-Cellulose with Increased Time of Alkaline Digestion. The Alkaline Digestion Had Been Preceded by Seven Hours of Neutral Digestion.

It is extremely interesting that the neutral butanol cooks caused such a low yield, obviously removing considerable quantities of carbohydrates. A report on the degradation products will be saved for a later communication.

Nature of the Ligno-Cellulose Bond

Naturally, it would be extremely interesting to know to which fraction of the total cellulose the lignin was combined; the answer does not appear to be evident in these data. Several facts seem certain, however, namely, that a ligno-pentosan was not present since lignin had the same resistance to solution after the pentosans had been extracted. Nor could this difference in the resistance of the lignin be laid to slightly different structure and hence different solubility, since the solvent was the same in each case. The experimental work, which will be discussed in a later paper, indicated that the important function of the alkali in this case was hydrolytic,

while the extracted lignin fractions had identical classification reactions. So identical or nearly identical are the properties of the two fractions that it cannot be definitely said as yet that the two isolated fractions actually are different chemically. Since pentosans were absent, the only other possibilities are that lignin was either combined with itself, i.e., a high molecular weight polymer, or, that it was combined with cellulose. The possibility of a high lignin polymer was studied by removing the cellulose from lignocellulose with both critical H_2SO_4 and critical cuprammonium at room temperature. The isolated lignin then went into solution in neutral butanol under the same conditions as in the usual digestion. It seems hardly likely that cold H_2SO_4 and cold cuprammonium would split a linkage which resisted a temperature of 158 deg. C. in alkaline solution for considerable time. These arguments would also apply with equal force against the possibility of a union between lignin and the fraction unaccounted for (100 per cent minus the sum of the per cent of Cross and Bevan cellulose plus the per cent of lignin) as would also the fact that the unknown fraction exists in quantities of from 5 to 10 per cent, completely uncorrelated with either time of digestion or lignin content. This material was resistant to alkaline digestion but was removed by the strong acid treatment (for lignin) and chlorine (for C. and B. cellulose), and quite probably was a partial-degradation product of carbohydrate origin.

The logical conclusion, therefore, would appear to be that some of the lignin in jack pine is combined in a true ligno-cellulose, while the remainder, and all of the aspen lignin, were not in true chemical combination with the cellulose. It is immediately apparent that a resistant linkage of this type has important industrial significance. The absence of a ligno-cellulose bond is in direct agreement with the interpenetrating systems of I. W. Bailey and Kerr. It also appears likely that the presence of chemically combined lignin might be indicative of a different morphological structure of lignin.

In conclusion, the following observations seem worthy of consideration: ligno-cellulose seems to be a definite compound, although the uniformity of its composition must await further knowledge of its sources and distribution. The existence of a ligno-cellulose bond does not appear to be a necessity in any given cellulose-lignin relation. Lastly, the use of butyl alcohol provides a valuable means of studying true ligno-celluloses.

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Specialties

Hard Papers. Hermann Burmeister, assignor to General Electric Company. U. S. pat. 2,137,155 (Nov. 15, 1938).—An impregnated and coated sheet is made by forming an intimate and uniform association of moist fibrous material and a binder consisting of finely-divided, solid, heat-curable synthetic resin having a melting point of at least 50 deg. C. and an initial hardening point at least 70 deg. C. above its melting point, subjecting the resulting composition to a heat treatment sufficient to remove practically all the moisture but insufficient to melt the resin, subjecting the practically dry composition to a heat treatment sufficient to melt the resin but insufficient to convert it to a hard infusible state, and then hardening the melted resin in place under heat and pressure.—A.P.-C.

Multiple Impregnation of Compressible Fibrous Webs. Milton O. Schur, assignor to Brown Company. U. S. pat. 2,132,863 (Oct. 11, 1938).—The invention provides a process for producing from a compressible single fibrous web an impregnated sheet whose surface portion is impregnated with a different material or concentration of the same material

than the interior portion or layer of the sheet. This is obtained by passing the compressible fibrous web through a bath of impregnating liquid binder, subjecting the impregnated web to light mechanical pressure, and finally passing it over an applicator roll which rotates partly submerged in another impregnating medium or a solution of the same impregnant but of different concentration from the first.—A.P.-C.

Treated Paper of Plasticized Character. Harold R. Dalton, assignor to John S. Water, Joseph F. Leete and himself. U. S. pat. 2,132,724 (Oct. 11, 1938).—Paper is impregnated with an aqueous solution of invert sugar and the reaction products formed by partially hydrogenating an aqueous solution of invert sugar (such reaction products including mannitol and sorbitol), in about the proportions: invert sugar 50, specified reaction products 25 and water 25 per cent.—A.P.-C.

Improvements in the Treatment of Porous Materials and Articles. Christopher Luckhaupt. Fr. pat. 830,151 (July 22, 1938).—The materials or articles are impregnated with a mixture of terpinol hydrate and one or more other substances which increase the resistance of the porous materials to water or other liquids, or to air, heat, electricity, bacteria or vermin. The treatment is carried out at a temperature at or above the melting-point of the mixture. Strontium glycerophosphate may be used when it is desired to increase the resistance to penetration by oils. Waxes, or triphenyl phosphate and cellulose acetate may be used when the materials are to be made impermeable to water. The process is applicable, among other products, to paper, paper pulp and articles made therefrom.—A.P.-C.

Process for the Production of a Homogeneous Plastic Material by Impregnation. G. H. Vulliet-Durand. Belg. pat. 429,656 (Aug. 31, 1938).—This is applicable more particularly to the impregnation of paper for imitation leather. The impregnant is solidified in the paper before removal of the solvent.—A.P.-C.

Web Materials Such as Those of Cotton Fibers Impregnated With Various Agents. Edward Hurst, assignor to United Cotton Products Company. U. S. pat. 2,142,397 (Jan. 3, 1939).—A membrane is formed of unspun fibers and is passed through an orifice while simultaneously passing through the orifice a current of air laden with an impregnating material and in a direction generally parallel to the length of the membrane, a different pressure being maintained on opposite sides of the membrane to cause some of the laden air to flow there through.—A.P.-C.

Manufacture of Parchment Paper. G. M. Clark, assignee of Paterson Parchment Paper Company. Brit. pat. 487,403 (Oct. 16, 1936).—A dry-wax-impregnated, vegetable parchment paper is produced. The body paper is lightly parchmentized so that substantially only the surface fibers are gelatinized, the paper retaining absorbency as much as possible. The paper is then dried and impregnated with molten wax. The wax is retained by absorption and not surface deposition, thus enabling the paper to be easily printed.—A.P.-C.

Washable Playing Cards. Béla Engel. Brit. pat. 494,179 (Oct. 21, 1938).—These are made of plies of chemical pulp paper impregnated with animal size, etc., and hardened with formaldehyde, etc., united by a water-insoluble adhesive such as a casein-formaldehyde adhesive.—A.P.-C.

Pliable and Soft Paper and Manufacture Thereof. Fritz Sommer, assignor to Chemische Fabric Grunau, Landshoff & Meyer Akt. Ges. U. S. pat. 2,137,310 (Nov. 22, 1938).—The softness and pliancy of paper, paper cloths and paper tissues is increased by the incorporation of water-soluble salts of condensation products of proteins or higher molecular protein cleavage products of the type of lysalbinic acid and soap-forming acids selected from the group containing higher fatty acids and resin acids into the paper pulp.—A.P.-C.

Manufacture of Molded Binder-Reinforced Fiber Articles of Pliant Character. Milton O. Schur, assignor to Brown Company. U. S. pats. 2,136,826, and 2,136,827 (Nov. 15, 1938).—*No. 2,136,826*—A seamless, molded, binder-reinforced, waterlaid fiber article is made by depositing from aqueous suspension fiber and an elastic binder (such as rubber, glue, viscose, etc.) into approximate article shape, compacting the article to remove free water and dewatering it to self-sustaining condition on the mold, removing the dried article, rewetting and stretching the article in rewetted condition to its final shape on another mold, and redrying the article on the second mold, thereby causing it to shrink against the mold. *No. 2,136,827*—Short-fibered wood pulp is deposited from suspension in air on to a hallow perforated mold under internal suction to form a fibrous structure of much greater thickness than that desired in the finished article. The mold and deposited fiber are placed on a support whose configuration corresponds essentially to the internal configuration of the mold and subjected to sufficient pressure to compress to the desired finished thickness.—A.P.-C.

Process for the Manufacture of Printing Paper. Atlas Ago Chemische Fabrik A. G., Molkau. Ger. pat. 656,507 (Sept. 12, 1935).—The paper is provided with a fine coating of cellulose ester lacquer which gives the paper a high polish and resistivity.—J.F.O.

Process for the Manufacture of Printing Paper With Both Sides Colored With Two or More Colors. Papierfabrik Scheufeln, Oberlenningen. Ger. pat. 655,784 (Dec. 20, 1935).—The paper is first coated in the usual manner on both sides with a material containing filler, and then colored on both sides simultaneously by color rolls in zones of various colors.—J.F.O.

Proofing Paper. Wilhelm Pelzer. Brit. pat. 496,465 (Nov. 30, 1938).—Fibrous material is impregnated by immersion in a bath containing a mixture of animal size, formaldehyde and hydrogen peroxide to delay hardening. In an example, a solution is prepared by adding 5 parts of glycerol, 1 to 2 parts of hydrogen peroxide and 4 parts of 40 per cent formalin to 7 parts of glutin that has been swollen for 24 hours in 83 parts of water and heated to 60 deg. C. To increase adhesion to the paper, etc., 1 to 2 parts of starch may be added. Flexibility may be increased by adding a small quantity of emulsifiable fat, such as 3 to 5 per cent of olein or wool fat.—A.P.-C.

Composite Reinforced Sheet Material. American Re-enforced Paper Co., Brit. pat. 487,885 (June 28, 1938).—A box corner stay strip is made by shrinking a paper strip by gumming or gluing 1 surface thereof, and then sticking to the ungummed surface another strip of material, e.g., paper, by means of an adhesive, e.g., asphalt, with transversely extending unspun reinforcing filaments (sisal), extending between the strips.—A.P.-C.

Fundamentals of Glassine Transparency*

Part III. Sheet Properties

By Dan B. Wicker[1]

Abstract

In this, the last of a series of three articles on glassine transparency, the results of a study of sheet properties are presented. It is concluded that surface characteristics of a sheet are important factors in determining transparency but not necessarily the limiting factors so far as the results of current commercial practice is concerned. The presence of air voids within the sheet has been found to be the single factor which has the greatest deleterious effect upon transparent qualities. The presence of mineral constituents in proportions of less than one per cent has been found to have a definite but minor effect upon quality. There is a lack of evidence to indicate that the maximum attainable transparency of glassine paper is seriously limited by the birefringent properties of cellulose fibers. The addition of a small amount of dye to the furnish for glassine paper seems to have a rather marked beneficial effect upon transparency. A photomicrographic study indicated that the residual effect of the contour of the paper machine wire upon the properties of the glassine sheet is the greatest contributory factor toward producing undesirable air voids. A discussion of the practical interpretation of the experimental results of the study is presented.

The first part of this series *(1)* described a group of commercial transparent sheets including cellophanes, glassines, and supercalendered waxing papers. The concept of transparency was discussed in terms of the visual response resulting from certain optical properties. The second part of the series *(2)* described an instrumental study of optical properties which are pertinent to transparency and correlated objective measurements of such properties with visual ranking of the samples. Herein will be presented a study of some of the more important sheet properties which are related to transparency, and correlations will be made to show which characteristics have the more critical effect upon quality. In addition, the various measurable qualities of the sheets will be discussed with reference to the maximum and minimum values which are representative of commercial practice and with reference to the possible means of seeking improvements.

General Considerations

It has been concluded from previous studies that the tendency of a sheet to transmit rays of light without their being scattered is a true indication of transparency as observed visually. From this conclusion it follows that those sheet properties which affect the manner in which rays of incident light react in transmission and reflection phenomena will in turn control transparency.

Upon passing a boundary between two dissimilar materials, rays of light have the property of changing direction; the change may be effected in a different manner upon different portions of the incident light beam and usually results in one portion assuming a direction of travel which is not the same as that of other portions. Only three factors control these phenomena, namely, the wavelength of the light, the relative optical density (as indicated by refractive indices) of the two materials, and the angle at which rays of light approach the boundary surface.

In passing through any material medium, light may be transformed into some other form of energy. This phenomenon of absorption is controlled by the wavelength of the light and the characteristics of the medium.

In the light of these facts it may be anticipated that the transparency of cellulose sheets will be controlled by a few relatively simple characteristics, namely: (1) the degree to which the surfaces of the sheet approach parallel planes; (2) the extent to which the interior of the sheet is free from materials which are optically dissimilar from cellulose (air, solid particles, etc); (3) the degree to which the various cellulose particles making up the sheet are optically similar (have the same refractive indices); (4) the characteristics of the sheet for selective absorption of light which is transmitted diffusely.

An exhaustive study of all of these factors was not found feasible in the course of a survey of commercial samples. However, the more important ones have been analyzed and will be discussed with regard to their relative effect upon transparency.

Surface Characteristics

It was found quite difficult to determine the specific relationship between surface characteristics and transparency. In the first place, smoothness is a property which is quite elusive of objective measurement; secondly, the transparencies of the samples were not controlled by surface characteristics alone but were observed to be even more strongly affected by other sheet properties. Thus it is not possible to measure, with the available samples, the independent effect of smoothness. The approach was to evaluate three different characteristics which are known to be affected by surface properties, namely Bekk smoothness, gloss and specular reflectance. Of these, only Bekk smoothness, in the case of supercalendered glassine samples, is relatively unaffected by the characteristics of the interior of the sheet. Glossy reflection (i.e., reflectance as viewed at an angle of 15 degrees to the surface) and specular reflection (as calculated from photometric data) occur at both sheet surfaces; hence, their value is determined in part by the transmittance properties of the sample.

Bekk Smoothness

The Bekk smoothness tester measures the relative size of surface irregularities by a method which is

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based upon the principle of change of rate of flow of a gas with change in area or diameter of the path of flow. Air, under a standard pressure differential, is forced through openings between a paper sample surface and a glass plate with which it is held in contact with a rubber cushion. The time required for escape of a standard volume is observed. It may be shown by the use of Poiseuille's law that the hydraulic radius of the effective path of flow between the glass plate and the sample surface is inversely proportional to the fourth root of the Bekk smoothness time. Thus the fourth roots of the Bekk smoothness times are given in the indicated column of Table I and their reciprocals are correlated with transparency ratio in Fig. 1. There were large differences both in the individual measurements taken on the same side of a given sample and in the averages for opposite sides of the sheet. The values reported represent averages for both surfaces.

There is undoubtedly a relationship between transparency and smoothness. The rather erratic data for papers are best correlated, using the method of averages, by the expression:

$$\text{Transparency Ratio} = 110.5 - \left(\frac{553.2}{\sqrt[4]{\text{Bekk smoothness time}}}\right).$$

That is to say, transparency appears to be a function of the size and number of surface irregularities, decreasing directly as the latter increase. However, the transparency ratio values for paper samples do not fairly represent the effect of smoothness on a sheet with a perfectly transparent interior, whereas cellophane, with an interior approaching perfect transparency, represents a limiting condition. In this case it was found that a very high transparency ratio was obtained with an exceedingly small, but finite, value for surface irregularities. Assuming a linear relationship of the same slope as that found for paper samples, the line "B" is an estimate of the limiting effect of surface smoothness upon transparency. If even approximately accurate, it indicates transparencies approaching perfection for surfaces giving Bekk smoothness values of about 40,000 seconds and essentially no transparency for surfaces which give a value of about 200 seconds.

Transparency ratio, as defined by this particular study, is based upon the determination of the percentage of parallel light which suffers changes of direction of less than about three degrees while passing through a sheet. If one considers an air and cellulose surface which is so rough that it can be assumed to have random distribution of the boundary planes, it can be shown mathematically that between 98 and 99 per cent of a beam of parallel light will, upon striking the surface, suffer change of direction greater than this limiting angle. Ordinary, non-transparent papers which have not been supercalendered will generally have Bekk Smoothness values of 200 seconds or less. Thus, independently observed facts do not contradict the conclusions drawn from the estimated limiting relationship between transparency and smoothness.

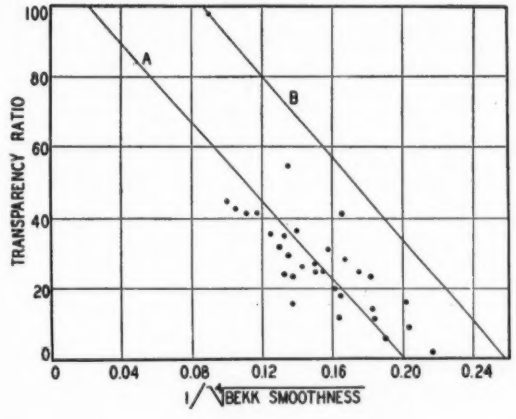


FIG. 1.
Relationship Between Bekk Smoothness and Transparency Ratio. A—Actual Average Relationship. B—Estimated Limiting Relationship.

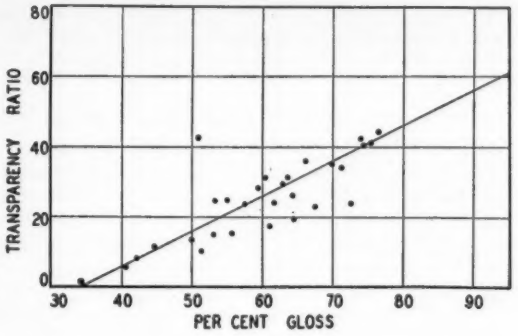


FIG. 2.
Relationship Between Per Cent Gloss and Transparency Ratio.

The Bekk smoothness values of the various types of papers investigated were found to be within the following ranges:

Supercalendered Waxing Papers	450- 1,000 seconds
Supercalendered Glassines	1,000-10,000 seconds
Cellophanes	20,000-70,000 seconds

GLOSS

Values for percentage gloss were observed by means of the Modified Oxford glossmeter. They appear in Table I and are presented graphically in Fig. 2. The data are reasonably well correlated by the relationship:

$$\text{Transparency Ratio} = (\text{Per cent Gloss}) - 34.$$

This indicates that transparency is directly proportional to the glossy qualities of the sheet surface. From the relationship one would expect cellophane to have greater than 100 per cent gloss and it was indeed found that its readings were higher than the scale of the instrument used, showing that it gave more glossy reflection than the standard glass plate. This phenomenon arose from the fact that cellophane was reflecting from two surfaces while the black glass standard was reflecting from only one. Thus, there is no doubt that the gloss values obtained were determined in part by the transparency characteristics of the samples.

Glassines gave gloss values between 50 and 75 per cent, whereas those for waxings ranged from 35 to 60 per cent.

SPECULAR REFLECTANCE

The photometric device described in Part II *(2)* of this series was used for determining specular reflectance values. The method of calculation is illustrated in Part II *(2)*. These values appear in Table I and are presented graphically in Fig. 3. The relationship between transparency and specular reflec-

tance seems to be more complicated than those between transparency and other properties affected by smoothness. The data are quite well correlated by the relation:

$$\text{Transparency Ratio} = 0.514\ (\text{Per cent Specular Reflectance})^{2.5}.$$

In view of the fact that specular reflectance is rather markedly affected by transparency qualities, this equation is probably an approximation of the empirical relation in a very complicated system and hence is hardly to be attributed any fundamental significance. However, it is well to note the apparent presence of a non-linear relationship, with an exponent of the order of magnitude of 2.5; the exponents found in other functions to be presented below are much higher.

In a summary of the results of the three foregoing measurements of surface characteristics, the evidence points to smoothness as a very important factor in determining transparency, but not necessarily the most important, nor the limiting factor, so far as commercial papers are concerned.

Non-Fibrous Inclusions

Air Voids

From a consideration of the glassine paper manufacturing process, one would expect to find air to be the most extensive foreign material present in commercial sheets. This was indeed found to be the case, in addition, air voids were found to have a very drastic effect upon transparency. In noting this tremendous effect it is well to bear in mind that air is quite dissimilar, optically, from cellulose and that this difference will have its effect so long as the voids are sufficiently large to separate fiber boundaries by more than a few millimicrons.

The amount of residual air in the sheets was evaluated by determining the solid fraction as defined by Doughty *(3)*. This procedure involves measurement of the volume of the paper sheet, its moisture-free weight, and, by difference, the percentage of the observed sheet volume which is not occupied by the observed weight of solid cellulose. In view of the fact that supercalendered glassine sheets have caliper measurements in the order of 0.001 inch, there is the possibility of errors of several per cent in evaluating

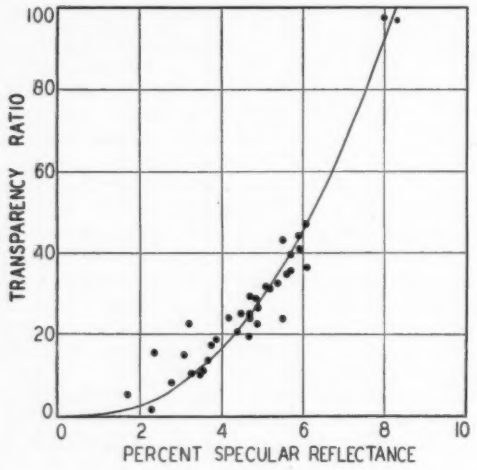


Fig. 3.
Relationship Between Percentage Specular Reflectance and Transparency Ratio.

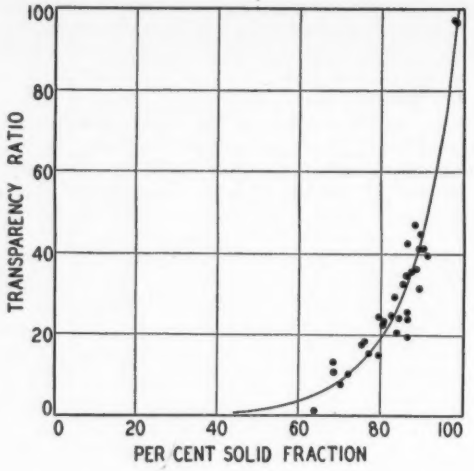


Fig. 4.
Relationship Between Percentage Solid Fraction and Transparency Ratio.

the solid fraction. Also, the caliper measurement involves the determination of the maximum rather than the minimum thickness of sheets, thus including in the solid fraction value the effect of surface irregularities. The data are presented in Table I and are correlated graphically with transparency ratio in Fig. 4.

TABLE I—TRANSPARENCY RATIO VALUES AND SHEET CHARACTERISTICS

Sample	Transparency Ratio	Solid Fraction Per cent	Ash Per cent	$\sqrt[4]{\text{Bekk Smoothness (Seconds)}}$	Gloss Per cent	Specular Reflectance Per cent
O-A, cellophane	97.6	97.9	0.14	14.26	...	8.0
O-B, cellophane	97.0	98.7	0.15	...	...	8.3
6-B', cal.	47.0	88.1	0.74	...	...	6.1
6-B', not cal.	2.80	47.5	0.78	...	...	0.0
3-B, cal.	44.3	88.9	0.49	9.95	76.6	5.9
3-B, not cal.	2.88	46.8	0.46	...	...	0.1
3-O, cal.	42.6	86.3	0.46	9.47	74.2	5.9
3-O, not cal.	2.87	47.9	0.44	...	...	0.0
3-C, cal.	41.1	90.6	0.51	8.48	74.3	5.9
3-C, not cal.	2.97	49.8	0.47	...	...	0.5
4-B, cal.	41.0	89.5	0.32	8.79	75.2	5.9
1-SL, cal.	39.8	91.1	0.29	...	...	5.7
1-SL, not cal.	3.62	58.4	0.36	...	...	0.3
4-D, cal.	36.2	88.8	0.30	7.14	66.2	6.1
1-S, cal.	35.3	87.7	0.37	7.92	70.0	5.7
1-S, not cal.	3.09	60.0	0.35	...	...	0.0
1-W, cal.	34.5	86.2	0.38	7.52	71.6	5.6
1-W, not cal.	3.38	53.5	0.37	...	...	0.1
6-D', cal.	32.7	85.3	0.82	...	...	5.4
6-D', not cal.	2.95	50.4	0.81	...	...	0.0
1-G, cal.	31.3	89.4	0.53	7.64	63.6	5.1
1-G, not cal.	3.02	54.5	0.45	...	...	0.0
4-A, cal.	29.3	83.2	0.25	7.33	63.0	4.7
4-E, cal.	26.5	85.8	0.28	6.65	64.4	4.9
7-A, cal.	24.9	82.5	0.80	6.65	55.0	4.7
7-A, not cal.	2.37	49.9	1.02	...	...	0.2
6-A', cal.	24.3	84.6	0.85	...	...	4.7
6-A', not cal.	2.39	51.0	0.85	...	...	0.2
W-C, cal.	24.3	79.0	0.50	6.46	61.8	4.2
5-A, cal.	24.0	86.9	0.57	7.50	72.7	5.5
5-A, not cal.	2.36	58.7	0.59	...	...	0.0
2-A, cal.	23.0	80.5	0.35	7.29	67.5	3.2
6-F, cal.	22.8	80.6	0.61	5.49	57.2	4.9
7-B, cal.	20.5	84.0	0.92	...	...	4.4
7-B, not cal.	1.82	55.6	0.91	...	...	0.0
1-B, cal.	19.5	86.4	0.37	6.18	64.6	4.7
1-B, not cal.	2.39	52.8	0.32	...	...	0.0
W-6-C', cal.	18.9	76.2	0.73	...	...	3.9
W-6-C', not cal.	1.17	44.6	0.79	...	...	0.2
W-G, cal.	17.6	75.7	0.80	6.05	61.3	3.8
W-A, cal.	15.7	77.3	0.34	4.96	55.6	2.4
W-B, cal.	15.0	79.9	0.47	7.30	53.2	3.1
W-H, cal.	13.6	68.6	0.84	5.45	50.0	3.7
W-6-E', cal.	10.6	69.0	1.03	...	...	3.5
W-6-E', not cal.	1.66	45.2	1.06	...	...	0.9
W-M, cal.	10.2	72.1	0.42	5.43	51.0	3.3
W-D, cal.	8.5	70.5	0.62	4.93	42.4	2.8
1-OP, cal.	5.73	77.4	6.55	5.28	40.9	1.7
1-OP, not cal.	0.75	53.4	7.16	...	...	0.0
W-E, cal.	1.6	64.0	0.87	4.62	34.3	2.3
W-6-E, cal.	11.3	...	...	6.10	44.8	3.6
W-6-C, cal.	24.9	...	...	5.71	53.2	4.5
6-A, cal.	28.2	...	...	5.98	59.6	4.9
6-B, cal.	43.0	...	...	6.02	51.0	5.5
6-D, cal.	31.0	...	...	6.36	60.4	5.2

"cal." refers to supercalendered sheets.
"not cal." refers to corresponding sheet before supercalendering.

The most striking observation to be made from a correlation of the two values is the tremendous change in transparency ratio as the solid fraction values increase from about 60 per cent. When the data for supercalendered sheets are plotted on logarithmic coordinates the points fall fairly close to two straight lines of different slopes. By applying the method of averages to the logarithms of the data involving lower transparency ratio values, the following expression was derived:

$$\text{Transparency Ratio} = 3.297 \times 10^{-10} (\text{Solid Fraction})^{9.6321}.$$

This indicates a maximum transparency ratio of 66.6 per cent with 100 per cent solid fraction and a very small value of transparency ratio at solid fraction values of about 60 per cent. Such a relationship is consistent with the findings of Doughty *(3)*. However, it cannot be assumed that it applies for solid fraction values lower than the range covered by the data, as Doughty found that at low values there is a reversal of effects due to large air spaces making for increased transparency.

By applying the same method of averages to the data of this study for samples of high transparency ratio (cellophanes excluded), a second expression was derived as follows:

$$\text{Transparency Ratio} = 3.608 \times 10^{-15} (\text{Solid Fraction})^{15.3554}.$$

This indicates a much greater effect upon transparency for a given change in solid fraction than that found with samples of lower quality. Transparency ratio appears to approach a maximum of 106.9 per cent with 100 per cent solid fraction. This maximum is, of course, a fallacious value as transparency ratio cannot, by definition, be greater than 100 per cent. Obviously the data are somewhat in error, but it is interesting to note the lack of evidence of the better glassine samples approaching a maximum limit of less than 100 per cent as might be expected from the birefringent property of cellulose fibers.

The two relationships have a common point at a solid fraction value of 83.3 per cent. In view of the fact that all of the waxing papers have lower values than this and most of the glassines have higher values, the one relationship may be looked upon as applying to waxings and the other to glassines.

The foregoing facts are suggestive of the possibility that fibrous sheets normally approach, with increased solid fraction, a limiting transparency of less than 100 per cent as might be expected from the birefringent property of cellulose and that, under the influence of heat and the tremendous pressure of the supercalenders, a change in the optical characteristics of the cellulose crystallite occurs, resulting in an approach toward perfect transparency. As unorthodox as this suggestion may seem, it would be highly interesting to determine whether x-ray or optical data can confirm or deny its validity.

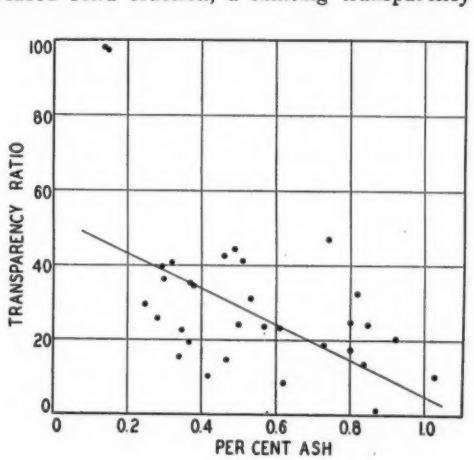


FIG. 5.
Relationship Between Per Cent Ash and Transparency Ratio.

For practical purposes it suffices to say that changes in solid fraction, or extent of air voids, has a far greater effect upon transparency than any other sheet property investigated. The upper limit for commercial practice seems to be about 90 per cent solid fraction with a transparency ratio of 45. Even a small increase above 90 per cent solid fraction may be expected to result in a marked improvement in transparency.

In order to determine solid fractions for glassine sheets it is necessary to have a very accurate caliper graduated in ten thousandths of an inch. After calipering, the samples should be oven dried before weighing; otherwise errors may be introduced which may lead to apparent solid fraction values greater than 100 per cent. In order to be comparable with the data given herewith, the density of wood cellulose should be taken as 1.54.

Mineral Constituents

Mineral constituents residual from the cooking or papermaking processes may be present in glassine paper. Such materials are usually calcium, aluminum or silicon compounds which have optical properties appreciably dissimilar from those of cellulose. Hence one may expect their presence to be detrimental to transparency. The samples under study were analyzed for ash content in order to evaluate the seriousness of this particular effect. The data appear in Table I and are correlated graphically with transparency ratio in Fig. 5. Although the correlation between the two values is not very close, there seems to be a definite decrease in transparency as the ash content increases. It is to be observed that the values found for ash content are of the order of magnitude of 1 per cent, or less. It is concluded that mineral constituents, when present in proportions of less than 1 per cent, have a minor but definite deleterious effect upon transparency; in greater proportions the effect is beyond doubt a more serious one.

The Effect of Birefringence

This study was primarily concerned with commercial glassine paper samples and was not extended to embrace an investigation of the birefringent properties of cellulose fibers. However, there are several inferences to be drawn in connection with the effect of birefringence upon the transparency characteristics of glassine sheets. The most important is the lack of evidence that transparencies obtained with current commercial practice are approaching a maximum which is limited by birefringent properties. It has been mentioned that, as solid fraction increases above 83 per cent, the transparency ratio appears to approach a maximum which is not far from 100 per cent. In a photomicrographic study of the better glassine samples, small localized areas could be found where it was impossible to resolve a fibrous structure of the sheet either with transmitted or reflected light. This leads to the conclusion that, whatever the ultimate limiting effect of birefringence may be upon

transparency, it is very small as compared to that of deviations from perfect sheet structure and that continued improvements in mill practice will result in corresponding improvements in transparency.

The Effect of the Presence of Dye

The glassine paper samples available for this study fell roughly into three groups with respect to the apparent amounts of dye used in the beater furnishes. One group seemed to have been treated with a fairly large amount of dye resulting in rather deep and dull tints; the second group had only faint tints and the third was composed of samples which were white and indicated the use of little or no dye. It is rather surprising and interesting to note that when the samples are so grouped, as in Table II, there is a

TABLE II.—GLASSINE SHEETS GROUPED ACCORDING TO THE APPARENT AMOUNT OF DYE USED

Sample	Tint	Transparency Ratio
Group 1 (relatively large amounts of dye used)		
6-B′, cal.	Dull Brown	47.0
3-B, cal.	Dull Green	44.3
6-B, cal.	Dull Brown	43.0
3-O, cal.	Dull Brown	42.6
3-C, cal.	Dull Brown	41.1
6-F, cal.	Dull Blue	22.8
	Average	40.1
Group 2 (small amounts of dye used)		
4-B, cal.	Light Green	41.0
1-SL, cal.	Light Gray	39.8
4-D, cal.	Light Brown	36.2
1-S, cal.	Light Gray	35.3
1-W, cal.	Light Green	34.5
6-D′, cal.	Light Green	32.7
1-G, cal.	Light Green	31.3
6-D, cal.	Light Green	31.0
4-A, cal.	Light Green	29.3
4-E, cal.	Light Green	26.5
2-A, cal.	Light Green	23.0
	Average	32.8
Group 3 (little or no dye used)		
5-A, cal.	White	28.2
7-A, cal.	White	24.9
6-A′, cal.	White	24.3
5-A, cal.	White	24.0
7-B, cal.	White	20.5
1-B, cal.	White	19.5
	Average	23.6

marked difference in the average transparency ratio of the three types of papers and that increased amounts of dye apparently make for increased transparency ratio. Of course, the possibility must be considered that this correlation is merely a matter of coincidence. However, when the definiteness with which the groups are separated is observed, it seems highly improbable that the differences observed are merely a matter of chance.

The question naturally arises as to the explanation of the apparent effect of dye upon such objective values as transparency ratio and percentage contrast visibility. Bearing in mind that transparency ratio is an expression of the relative values of diffuse and parallel transmittance, it seems entirely logical that, when the quantities of light energy representing these two values follow paths of different length in passing through the sheet, the absorbing action of dye must have a greater effect upon the one following the longer path. Assuming illumination with a parallel beam at normal incidence, scattered light undoubtedly follows a somewhat longer path in passing through the sheet than that which remains essentially parallel. Thus it seems reasonable to expect that the presence of dye will decrease diffuse transmittance more markedly than parallel transmittance, with a resultant increase in transparency ratio and transparency as observed visually. This result can be expected only within the range of light energy values for which Fechner's rule is valid; hence it would not obtain for deeply dyed sheets.

In Part I *(1)* of this series it has been pointed out that, when light-transmitting sheets have negligible diffuse reflectance values, their contrast visibilities are independent, within the limits of Fechner's rule, of light absorption. It was also pointed out that under these conditions a reduced contrast will become more vivid when a printed surface is covered with a transparent sheet, the point being illustrated by the cases of seven of the glassine samples presented in the Photographic Series illustration. Thus, the better glassines are concluded to fall within the range where diffuse reflectance is approaching a negligible value and where contrast visibility is relatively independent, within limits of Fechner's rule, of the transmittance characteristics of the sheet. Therefore it seems reasonable to expect that the addition of dye to the furnish will, by further reducing diffuse reflectance, increase the contrast visibility of the resultant sheet.

In view of the fact that the longer wavelengths of red light are refracted less than those of blue light, one would expect that the use of a reddish or brown dye would have the strongest tendency to reduce scattered light energy values, a blue dye the least tendency, and a green dye an intermediate tendency. The data are not inconsistent with this expectation, although they do not positively confirm it.

Considered from the practical standpoint, all the evidence points to an apparent improvement in transparency resulting from the use of a small amount of dye in a fairly transparent sheet. It seems that this improvement is more marked for the deeper and duller colors, particularly brown, and it is believed that advantage may be taken of the benefits to be derived from the use of great quantities of dye up to the point where the attendant dye cost, or the resultant color of the sheet, constitutes a trade objection.

Photomicrographic Study

A photomicrographic study of samples selected to embrace the entire range of transparency characteristics was carried out. The results of this investigation served, for the most part, as confirmation of conclusions reached by other methods of approach. In general, increased transparency was found to follow with smoother surfaces and more uniform formation; by far the most deleterious effect upon transparency was traced to air voids within the sheet structure. The better qualities of glassines gave photomicrographs which left inconclusive the point as to whether or not the birefringent properties of cellulose fibers place an appreciable limitation upon the ultimate transparency which may be obtained with a glassine sheet. Certainly the effect of birefringence is vastly overshadowed by that of residual air voids, even when the latter are present only to the exent of ten per cent of the sheet volume.

Figure 6 is a photomicrograph of sample 6-A′, calendered, a bleached white glassine of medium transparency. The illumination system with which it was made was such that parallel transmitted light was focused upon the photographic plate and that diffusely transmitted was eliminated. Thus light areas represent highly transparent portions of the sheet and dark areas indicate the points where air voids are present and interfere with transparency. Photomicrographs with a different illumination arrangement lead to the conclusion that these dark portions

correspond to actual air voids within the sheet and not to surface irregularities.

Careful examinations of the photomicrograph will reveal that the imperfections form a more or less regular pattern, being arranged in rows horizontally (corresponding to the machine direction) and vertically (corresponding to the cross direction). The rows parallel to the machine direction are not as obvious and not as far apart as those parallel to the cross direction. When account is taken of the fact that during drying and supercalendering the sheet undergoes shrinkage in one direction and the stretching effect of tension in the other, the dimensions of this pattern are almost identical with those of the paper machine wire upon which the sheet was made. Thus the imperfections are the usual wire marks and such wire marks have been shown to be largely residual air voids within the sheet rather than surface imperfections.

An explanation of this phenomenon may be found from an analysis of the results of forming the sheets on the wire under the influence of suction. During the sheet formation the finely divided and well beaten stock must inevitably shape itself to the contour of the wire mesh; the more drastic the suction the more marked will this effect be. Thus the sheet leaves the wire with alternate protuberances and recessions on the wire side and a relatively plane surface on the felt side. To the extent that the wet presses fail to remove this condition by lateral displacement of the fibers at the points of protuberances, the sheet leaves the paper machine with alternate portions of perhaps the same thickness but containing different amounts of fiber per unit of sheet area. In addition the fibers are fixed in place by the bonding action resultant from drying. As this bonding action is only partially removed by dampening, the effect of stack pressure during supercalendering is selectively exerted on the denser portions of the sheet. That is to say, during compression of the surfaces to planes, the air is effectively forced out of those portions which originally corresponded to protuberances and are relatively dense; but voids are left at portions which correspond to recessions and contain less fiber. These voids will, of course, be points of low transparency even though the adjacent surfaces have been brought to a high degree of smoothness.

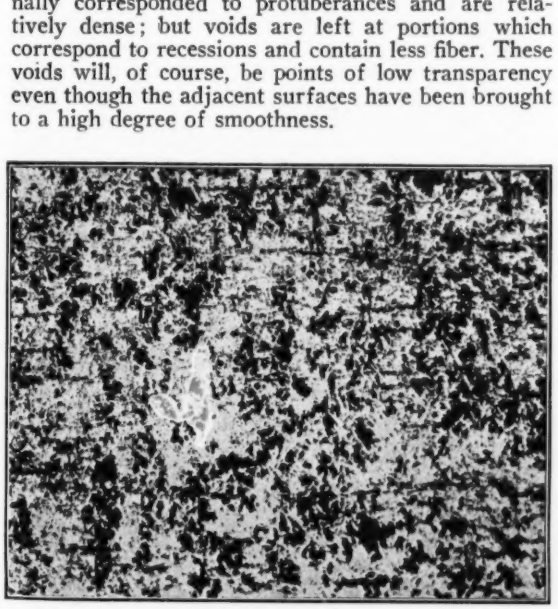


FIG. 6.
Photomicrograph of Calendered Glassine, Sample 6-A', with Transmitted Light and 18 Diameters Magnification.

By application of the same line of reasoning one may expect deleterious effects upon transparency to result from fiber clots or a wild formation of the sheet.

Practical Interpretations

From the foregoing study there are a number of practical interpretations and suggestions which seem worthy of discussion. No attempt will be made to cover the generally recognized practices which are necessary in glassine manufacture, but the discussion will emphasize those which are indicated as being more important and to discuss such novel suggestions as may have presented themselves.

Two Outstanding Conclusions

There are two outstanding conclusions which have bearing upon the practical aspects of glassine manufacture. In order to obtain maximum transparency every step of the process must be directed toward the primary objective of producing a sheet of maximum uniformity, both with regard to physical structure and chemical composition. Small irregularities of a nature which may be of no consequence in the production of other papers may have very serious effects upon glassine transparency. In addition, it must be kept in mind that the results of any one step in the process carries through as residual properties of the sheet, even though not apparent at that particular point, and may become obvious as a secondary effect of some later manufacturing operation. In almost all respects corrective steps for overcoming the deleterious effects from the practice of earlier stages of the process leave much to be desired.

Advantages of Long-Fibered Stock

With the thought of uniform formation in mind, it is recommended that beating pratice be directed toward the production of a fairly slow stock with a relatively long fiber. There are many advantages to accrue from the use of a long-fibered stock, as compared to one consisting largely of fines, among which are increased strength, less brittleness, etc. With regard to transparency, however, the paramount purpose is that of having the average fiber length sufficient to bridge the openings in the wire rather than enter into them. It is highly probable that under these conditions the effect of wire markings will be reduced. In addition, on account of its faster drainage rate, one may expect the satisfactory formation of a long-fibered sheet with the use of milder suction. This will permit the sheet to leave the couch roll without having been so drastically forced into the contour of the wire and having a looseness of structure which will more readily permit lateral or sliding movement of the fibers under the action of the wet presses with the result of a more uniform sheet density.

The maximum fiber length permissible on glassine paper machines is usually determined by the conditions under which fiber clots will appear resulting in a "wild" sheet formation. For this reason alone, if for no other, jordans are customarily employed with adjustments which cause appreciable decreases in average fiber length. The incorporation in the machine white water of agents which have a dispersing effect upon paper fibers seems worthy of trial for avoiding this necessity and accomplishing a more uniform sheet formation.

The relative beneficial effects upon formation of

long wires, low vacuum in the suction boxes, and the usual adjustments of consistency, heads, slices, outlets, etc., cannot be discussed adequately in this paper as conditions are highly variable among individual cases. However, it is to be emphasized that, when the maximum removal of water is accomplished on the wire, the action of the wet presses has a minimum effect in determining the characteristics of the sheet. On the other hand, if the sheet leaves the wire relatively wet, and hence more plastic, the action of the press rolls is more effective in eliminating residual wire marks. Undoubtedly any effective steps for reducing or eliminating the residual effect of the wire contour must be accomplished between the removal of the sheet from the wire and the point in drying where the fibers have bonded together to an appreciable extent. It is entirely possible that the use of additional smoothing presses, even after the sheet has been heated by passing over drying drums, might result in decidedly beneficial results to transparency.

Possibility of Using Pick-Up Felt

In this regard, it seems worth while to consider the possibility of using a pick-up felt to remove the sheet from the wire with an appreciably higher water content than is practical with the ordinary method of removal from the couch roll. Further removal of water might be accomplished by passing through a series of small rolls of gradually increasing pressure, employing the principle used on certain types of cylinder machines manufacturing paper board. Finally, press rolls of the usual type might be employed, followed by smoothing rolls. By this procedure, the final form in which the sheet is dried would tend to be shaped by the smooth surfaces of the rolls rather than have such a serious residual effect of the wire contour as is experienced with present normal practice.

It is not new to point out that transparency is benefited by refraining from complete drying of the sheet until the final supercalendering stage is reached. The irreversibility of certain of the water imbibition effects of the cellulose fibers results in a sheet which has never been completely dried being more plastic and responding better to the compressing action of the supercalenders than if dried and remoistened. It is not at all against observed facts to say that, by taking advantage of this phenomenon, a satisfactory glassine sheet can be produced from stock which has received less beater development than is the average practice and can be formed into a sheet at higher machine speeds. The problem is largely a mechanical one of developing a suitable rewinder for handling a damp and lightweight sheet without trouble from wrinkles.

Experienced Operator Necessary

It is hardly necessary to point out to those familiar with the process that constant care by a skilled and experienced operator is necessary to obtain the optimum results from supercalendering. The results of this study suggest that the changes occurring during supercalendering are even more fundamental than those taking place in the papermaking process. If this may be taken as the case, then supercalendering is the critical step in glassine manufacture and the remainder of the process is merely a matter of producing the sheet which is most adaptable to supercalendering. It is the experience of the writer that frequently poor quality appears at the supercalenders as a secondary result of improper practice at other stages. Thus, it is eminently desirable that the process as a whole be subjected to routine surveillance and technical analysis; otherwise the relation between practices in early stages and results which appear only in the final product can very easily be overlooked.

The criterion of quality resulting from the supercalendering process seems to lie in uniformity, i.e., uniformity in distribution of moisture in the sheet, uniformity of sheet weight and density, uniformity in distribution of pressure across the sheet, uniformity in the surface conditions of the calender rolls, and even uniformity in the type of sheet which is processed on a given stack.

There are number of agents which can be applied to supercalendered glassine sheets to accomplish more or less improvement in transparency. The quality of these converted products is inevitably limited by the quality of the base paper sheet upon which the coating is applied. This arises from the fact that the air voids within the sheet need be only of the order of magnitude of the wavelength of light to have an interfering effect upon transparency. Such small voids may be, and to a large extent are, sealed from connection with the surface of the sheet, thus removing the possibility of forcing a saturant into them to displace the air. Hence, the effect of coating is limited to the elimination of surface irregularities which, although important, are not limiting factors of glassine transparency.

Many Practical Difficulties

From the nature of glassine paper, one would expect that the optimum effect of any saturating material would be obtained by incorporating it before supercalendering, and, if possible, during or soon after sheet formation. That is to say, the more care given to assure uniform distribution, the more satisfactory the results which may be expected. However, this practice is accompanied with many practical difficulties. If the incorporated material has appreciable lubricating qualities, a slippery sheet will be produced which cannot be run through the supercalenders on account of slippage and cutting at the nips. On the other hand, if the saturant has appreciable adhesive properties, the sheet will stick to and wind around the calender rolls.

Although many such saturating substances have been tried, no completely satisfactory one has come to the attention of the writer. This is undoubtedly due to the requisite qualities which are as follows: (1) the material should have suitable optical properties for improving transparency; (2) it should be compatible with water and cellulose; (3) it should be free from adhesive and lubricating qualities; (4) it should not detract from and, preferably, should improve sheet pliability; (5) it should not detract from and, preferably, should improve grease resistance.

Most Promising Line of Endeavor

In view of the rigid specifications necessary for such a material, it is believed that the most promising line of endeavor for improvement of glassine transparency lies in development of papermaking practice for producing from the paper machine a damp sheet of the highest degree of uniformity in density and thickness.

Literature Cited

1. Wicker, D. B., *Paper Trade J.* 105 no. 17:31-40 (Oct. 21, 1937).
2. Wicker, D. B., *Paper Trade J.* 107, no. 17:44-54 (Oct. 27, 1938).
3. Doughty, R. H., *Paper Trade J.* 93 no. 2:39-44 (July 9, 1931); 95 no. 10:31-8 (Sept. 8, 1932).

Imports of Paper and Paper Stock

Giving Manifests of New York, Boston, Philadelphia and Other Ports of Newsprint, Wrapping, Writing, Coated, Blotting, Tissue, Strawboard, Wallboard, Cigarette Papers, Sulphite, Kraft and Ground Wood Pulp.

NEW YORK IMPORTS

WEEK ENDING DECEMBER 30, 1939

SUMMARY

Wall paper....8 bls., 9 cs.
Painting paper....17 cs.
Newsprint....4,439 rolls
Printing paper....92 cs.
Wrapping paper....105 bls., 560 rolls
Kraft paper....168 bls., 247 rolls
Filter paper....106 cs.
Filter compound....30 bls.
Basic paper....19 cs.
Tracing cloth....66 cs.
Tissue paper....37 cs.
Marble paper....2 cs.
Music paper....6 cs.
Miscellaneous paper..2 pkgs., 100 bbls., 647 rolls, 26 bls., 3 cs.

WALL PAPER

S. K. Lonegren, ——, Gothenburg, 6 cs.
F. J. Emmerich, —— Liverpool, 8 bls., 3 cs.

PAINTING PAPER

——, ——, Havre, 17 cs.

NEWSPRINT

Gilman Paper Co., ——, Gothenburg, 239 rolls.
National Pulp & Paper Co., *Bergensfjord,* Nygard, 580 rolls.
Jay Madden Corp., *Karin Thorden,* Kotka, 1,111 rolls.
Jay Madden Corp., *Astrid Thorden,* Helsingfors, 290 rolls.
Jay Madden Corp., *Astrid Thorden,* Kotka, 568 rolls.
H. Reeve Angel & Co., Inc., *Astrid Thorden,* Kotka, 453 rolls.
Jay Madden Corp., *Brita Thorden,* Kotka, 1,024 rolls.
Jay Madden Corp., *Brita Thorden,* Helsingfors, 174 rolls.

PRINTING PAPER

Dingelstedt & Co., *Bloomersdyk,* Rotterdam, 92 cs.

WRAPPING PAPER

Jay Madden Corp., *Brita Thorden,* Helsingfors, 105 bls., 560 rolls.

KRAFT PAPER

Swedish Paper Corp., ——, Gothenburg, 247 rolls, 168 bls.

FILTER PAPER

E. H. Sargent & Co., ——, Gothenburg, 12 cs.
E. Fougera & Co., ——, Havre, 94 cs.

FILTER COMPOUND

J. E. Bernard & Co., *E. Francqui,* Antwerp, 30 bls.

BASIC PAPER

R. Wilson Paper Corp., *Black Hawk,* Antwerp, 19 cs.

TRACING CLOTH

E. Dietzgen & Co., ——, Liverpool, 11 cs.
——, ——, Liverpool, 55 cs.

TISSUE PAPER

Van Oppen & Co., *Excambion,* Genoa, 37 cs., (uncoated).

MARBLE PAPER

Tamm & Co., *E. Francqui,* Antwerp, 2 cs.

MUSIC PAPER

——, ——, Havre, 6 cs.

MISCELLANEOUS PAPER

The Borregaard Co., Inc., ——, Gothenburg, 647 rolls, 8 bls.
S. K. Lonegren, ——, Gothenburg, 1 cs.
Globe Shipping Co., *Black Hawk,* Antwerp, 2 pkgs.
Walker Goulard Plehn Co., Inc., *Brita Thorden,* Helsingfors, 18 bls.
Miller, Bryant, Pierce Co., *Brita Thorden,* Helsingfors, 33 bbls.
Manifold Supplies Co., *Brita Thorden,* Helsingfors, 2 cs., 67 bbls.

RAGS, BAGGINGS, ETC.

W. Steck & Co., *Examelia,* Alexandria, 327 bls. old bagging.
R. Blank, *Examelia,* Alexandria, 100 bls. old white cottons, 91 bls. old cotton rags.
National City Bank, *Pennland,* Antwerp, 72 bls. rayon waste.
W. I. Chudleigh, *Black Hawk,* Rotterdam, 36 bls. rags.
Chase National Bank, *Black Hawk,* Antwerp, 31 bls. card waste.
National City Bank, *Flying Cloud,* Montevideo, 183 bls. rags.
——, ——, *Liverpool,* 42 bls. rags.

CASEIN

A. Hurst & Co., *Uruguay,* Buenos Aires, 1,000 bags.
——, *Uruguay,* Buenos Aires, 834 bags.
——, *Mormacwren,* Buenos Aires, 863 bags.
——, *Flying Cloud,* Buenos Aires, 2,590 bags.

WOOD PULP

Castle & Overton, Inc., ——, Gothenburg, 1,200 bls. dry pulp.
Bulkley Dunton Pulp Co., Inc., ——, Gothenburg, 2,750 bls. dry sulphite.
J. Andersen & Co., ——, Gothenburg, 300 bls. dry bleached sulphite.
D. M. Hicks, Inc., ——, Gothenburg, 450 bls. sulphite.
E. M. Sergeant Pulp & Chemical Co., *Bergensfjord,* Nygard, 250 bls. dry bleached sulphite, 50 tons.
Pulp Sales Corp., *Grete,* Rauma, 2,701 bls. prime bleached sulphite, 457 tons, 1,975 bls. prime strong sulphite, 395 tons.
Pulp Sales Corp., *Brita Thorden,* Helsingfors, 130 bls. prime sulphate, 26 tons.

WOOD PULP BOARDS

Newark Brush Co., ——, Gothenburg, 39 crates.

ALBANY IMPORTS

WEEK ENDING DECEMBER 30, 1939

Price & Pierce Ltd., *Bris,* ——, 5,930 bls. bleached sulphite.
Price & Pierce, Ltd., *Garnes,* ——, 3,000 bls. unbleached sulphite.

BOSTON IMPORTS

WEEK ENDING DECEMBER 30, 1939

American British Chemical Supplies, *Mormac Gull,* Buenos Aires, 834 bags casein, 50,040 kilos.
Price & Pierce, Ltd., Peiping, ——, 3,600 bls. unbleached sulphate, 750 bls. bleached sulphate.

PHILADELPHIA IMPORTS

WEEK ENDING DECEMBER 30, 1939

Castle & Overton, Inc., *Examelia,* Alexandria, 189 bls. rags.
E. J. Keller Co., Inc., *Examelia,* Alexandria, 80 bls. white cotton rags, 147 bls. old cotton rags, 35 bls. old rags.
Pulp Sales Corp., *Brita Thorden,* Kotka, 3,188 bls. prime strong sulphate, 601 tons; 125 bls. prime bleached sulphate, 25 tons; 310 bls. prime strong sulphite, 62 tons; 210 bls. prime bleached sulphite, 42 tons.
Pulp Sales Corp., *Brita Thorden,* Helsingfors, 635 bls. prime sulphate, 137 tons; 160 bls. bleached sulphite, 26 tons.
Neidich Process Co., *Brita Thorden,* Helsingfors, 269 bbls. tissue paper.
——, *Mormacwren,* Buenos Aires, 600 bags casein.
——, *Flying Cloud,* Buenos Aires, 1001 bags casein.

BALTIMORE IMPORTS

WEEK ENDING DECEMBER 30, 1939

Jay Maden Corp., *Astrid Thorden,* Kotka, 1,421 rolls newsprint.

NEWPORT NEWS IMPORTS

WEEK ENDING DECEMBER 30, 1939

Price & Pierce, Ltd., *Tampa,* ——, 135 bls. bleached sulphite.

Price & Pierce, Ltd., *Uddeholm,* ——, 4,350 bls. unbleached sulphite.

HOUSTON IMPORTS

WEEK ENDING DECEMBER 30, 1939

——, ——, Manchester, 602 bls. bagging, 231 bls. paperstock.

NEW ORLEANS IMPORTS

WEEK ENDING DECEMBER 30, 1939

Pagel Horton & Co., Inc., *Braheholm,* Sweden, 6,066 bls. wood pulp.

LOS ANGELES IMPORTS

WEEK ENDING DECEMBER 30, 1939

——, *West Portal,* Buenos Aires, 162 tons old rags.
——, *Benjamin Franklin,* Oslo, 107 rolls newsprint.
——, *West Irma,* Buenos Aires, 49 tons old rags.

The Answer Is In the Dictionary of Paper

The latest fad in radio programs seems to be the question and answer hour. The questions cover the whole gamut of human knowledge and a perfect score is more a matter of lucky guesses than actual knowledge. The Dictionary of Paper would offer an interesting source of material for a quiz of papermakers; it is suggested that, in spite of his general knowledge of the field, no one man could answer correctly more than a fraction of the questions asked him; the other answers would be guesses, and not all of them would be "lucky."

A few examples may be of interest.

We speak glibly of antique and eggshell finishes. Is there a difference and, if so, just what is this difference? Which is the smoother of the two? How would one distinguish them? The dictionary lists and defines at least fifty other types of finishes, excluding the large number of purely descriptive names used by various manufacturers.

Both the papermaker and the paper consumer are familiar with such defects in paper as the presence of dirt, grease spots, etc.; the printer is very conscious of curl in paper and the coated paper manufacturer is bothered with the problem of overcoming picking of his paper. But what are fish eyes, grainy edges, snailing, and wash board marks, to mention only a few of the more than sixty defects which are defined and described throughout the dictionary.

Physical properties have always played an important part in the buying and selling of paper, as well as in laboratory and development work. Recent interest in printing has introduced such terms as printability, printing capacity, printed capacity, hygroexpansivity, etc. Starting with abrasiveness and ending with wettability at least sixty physical properties are defined and in many cases, their relation to the paper sheet is given.

In the compilation of the dictionary many types of papers have been encountered, definition of which was not an easy task. For example, "square paper" might be paper that has been trimmed square but the term is actually used to describe a paper which has equal tensile and tearing strength in both machine and cross-machine direction. Tanning and pouncing papers are abrasive papers used in the leather and hat industries, respectively. Frozen foods have raised the question of the proper type of paper for their correct packing; the characteristics of this paper are given. Lead pencil paper is not only a paper used for writing upon with a lead pencil but a paper used in the manufacture of the pencils themselves. In addition to these special papers, all of the known papers are defined, whether they be used for writing, wrapping, printing, or converting operations. Boards and bristols of all types are included.

Fibrous raw materials are covered in the chapter on pulps, which also discusses pulping methods, the various grades of mechanical, sulphite, sulphate, soda, rag, and other pulps and the types of paper which may be manufactured from them. Waste materials used by the paper, board, and roofing felt industries are also included. For the first time an attempt has been made to classify and define the waste papers which are used by the book-paper mills; while it is not official, it is a step in the right direction.

The above are some of the items that may be found in the forthcoming Dictionary of Paper, which is being published by the American Paper and Pulp Association. The committee in charge of the compilation of the volume does not claim to be infallible and further recognizes that many definitions are a compromise to represent the average practice of the industry. It is evident, however, that the present volume has assembled a wealth of information which could not be duplicated by an individual or even a large mill organization within any reasonable length of time.

An announcement of this book appears in this issue. Please observe that the pre-publication price expires on February first.

American Box Board Co. Expands

The American Box Board Company of Grand Rapids, Mich., a Michigan corporation, effective December 1, 1939, has purchased the land and buildings at the outskirts of North Tonawanda formerly owned by the R. G. Kittinger Shops, Inc. The company plans to develop it as an Eastern base for the manufacture of corrugated shipping containers and kindred products, and for use as a distributing warehouse for solid fiber shipping containers and folding paper boxes. This new plant will be known as the American Box Board Company, Inc., Buffalo Division.

The American Box Board Company, starting from a small plant in 1903 making folding boxes, has developed into an organization which today in Grand Rapids produces annually in excess of 40,000 tons of box board, manufacturing this tonnage in its three paper mills in Grand Rapids through its integrated box plants at that point into corrugated and solid fiber shipping containers, folding paper boxes, clothing boxes, etc. The company also has a manufacturing plant for corrugated containers in Chicago.

It is anticipated that the paper board for the operation of the machines in the Buffalo Division will come from the company's Grand Rapid plants as well as from the South.

The plant is being equipped with machinery of the latest manufacture and design, installation of which began in January of this year.

Latest Review of Paper and Pulp Markets

Domestic Production of All Kinds of Paper For 1939 Is Estimated At 13,250,000 Tons Which Is An All-Time High Record — Pulp Markets Strong — No. 1 Mixed Paper Drops To .27½ To .32½—Others Slow.

Office of the PAPER TRADE JOURNAL,
Wednesday, January 3, 1940.

The past year closed with paper production at a high level, with most mills operating at practical capacity and with good volume reported in all distributing centers. The total domestic production of all kinds of paper for 1939 is estimated at 13,250,000 tons, which is an all-time high record for the industry. Prior to Christmas, wholesale volume tapered off in what is generally viewed as a normal seasonal manner. Despite the often repeated statement that the great splurge in buying which reached its peak in October was largely speculative, latest reports indicate that the inventories of general paper merchants are moderate.

Manufacturers' dollar sales for November 1939, show that the total gain in paper and allied products was 25.5 per cent. The increase in writing paper, etc. was 18.2 per cent, paper boxes and other paper products, 33.7 per cent, wax paper 19.2 per cent and wall paper 16.6 per cent. Printing, publishing and allied industries gained 6.0 per cent. These figures are comparative with November, 1938.

The dollar volume of all wholesale trade in November, 1939 was up 9.2 per cent over November, 1938. Total sales of 2,814 wholesale firms in November amounted to $217,124,000, compared with sales of $198,807,000 for November 1938. Paper and its products gained 18.5 per cent. End of month inventories (cost) gained 3.4 per cent.

The index of general business activity declined to 105.7 per cent for the week ended December 23, from 106.6 per cent for the previous week, compared with 91.6 per cent for the corresponding week in 1938.

Paper production of 139 mills for the week ended December 23 was estimated at 97.2 per cent, compared with 75.9 per cent for the like week in 1938, with 48.6 per cent in 1937, and with 66.3 per cent for the corresponding week in 1936.

Paper board production for the week ended December 23, was 81.0 per cent, compared with 69.0 per cent in 1938, with 48.0 per cent in 1937, and with 63.0 per cent for the like week in 1936.

No change of importance has been reported in the newsprint market during this week. Imports of newsprint at New York for the week ended December 23 totaled 2,428 rolls.

Mechanical Pulp

No important change has been reported in prices or demand for mechanical pulp during the current week. Consumption continues at a high level and the supply of groundwood has been relatively limited for many months as lack of water this year has forced curtailment of production.

Chemical Pulp

No important change in the chemical pulp market has been reported this week. Prices are firm with the market reported strong. According to latest information received from the State Department by the Association of American Wood Pulp Importers, the German Government has released all but one Swedish ship with cargoes of wood pulp consigned to this country.

Old Rope and Bagging

Trading in old rope fell off seasonally during the holiday and inventory periods, with mills reported buying steadily. No change in prices has been reported to date.

Trading in old bagging was quiet over the holidays and continues quiet at this date. Prices are unchanged.

Rags

Trading in all grades of new and old domestic rags is reported as slow at this date. Lower prices are currently quoted on many grades of new and old rags. No. 1 new white shirt cuttings are currently quoted at from 7.25 to 7.50, and No. 1 roofing rags at from 1.50 to 1.55.

Old Waste Paper

Mill buying has been more limited during the holiday and inventory period as most mills closed down. No. 1 mixed paper is currently quoted at .27½ to .32½, white ledger stock has been advanced to 1.60 and 1.70, and white envelope cuttings are currently quoted at from 3.10 to 3.25.

Twine

Seasonal tapering off in the demand for all grades of twine is reported this week. Prices hold unchanged, with the outlook considered favorable in many quarters of the trade.

More Rayon Pulp for Japan

[FROM OUR REGULAR CORRESPONDENT]

WASHINGTON, D. C., December 26, 1939—An increased demand for rayon pulp from the United States and Canada is anticipated from Japan as a result of conditions in Europe and the consequent difficulty which is anticipated in receiving regular shipments of pulp from Scandinavian countries. Due to the scarcity of foreign exchange which has prevailed in Japan during the past 2 years, imports of foreign rayon pulp have been reduced to a minimum and rayon manufacturers have been forced to operate with inadequate supplies of the high-grade pulp required for the production of rayon and staple fiber for export markets. During the current year, licenses for the importation of foreign pulp have been issued to the extent of only 55,000 metric tons of which 27,000 tons, or 49.9 per cent, was to have been supplied by Scandinavian countries. These licenses were issued in June for June-December shipment.

Miscellaneous Markets

Office of the PAPER TRADE JOURNAL,
Wednesday, January 3, 1940.

BLANC FIXE—Quotations on blanc fixe are firm under a good demand. the pulp is currently quoted at from $42.50 to $45 per ton, in bulk; the powder is offered at from 3½ to 3¾ cents per pound, in barrels, at works.

BLEACHING POWDER—Prices on bleaching powder are firm under a good demand, with prices unchanged at prevailing market levels. Bleaching powder is currently quoted at from $2 to $2.85 per 100 pounds, in drums, at works.

CASEIN—Quotations on casein are a little lower for this week. Standard domestic casein, 20-30 mesh, is currently quoted at 16 cents per pound; 80-100 mesh, at 16½ cents per pound. All prices in bags, car lots. Argentina casein, 20-30 mesh, is currently quoted at 14 cents per pound. Quotations on French casein at from 14 to 14½ cents per pound are nominal.

CAUSTIC SODA—Prices on caustic soda are firm under a good demand. Solid caustic soda is currently quoted at from $2.30 to $2.40 per 100 pounds; flake and ground at from $2.70 to $2.95 per 100 pounds, in drums, at works.

CHINA CLAY—Quotations on china clay are reported firm under a good demand. Domestic filler clay is currently quoted at from $7 to $15 per ton; coating clay at from $11 to $22 per ton, at mines. Imported clay is quoted at from $13.50 to $25 per ton, ship side.

CHLORINE—Prices on chlorine continue firm under a good demand and conform to prevailing market levels. Chlorine is currently quoted at $1.75 per 100 pounds, in single-unit tank cars, f.o.b., works.

ROSIN—The rosin market is reported as firm for the week, with prices on most grades unchanged. "G" gum rosin is currently quoted at $5.10 per 280 pounds, gross weight, in barrels, Savannah. "FF" wood rosin is quoted at $4.90 per 280 pounds, gross weight, in barrels, New York. Seventy per cent gum rosin size is offered at $2.78 per 100 pounds, f.o.b., shipping point.

SALT CAKE—Prices on salt cake continue very firm under a heavy demand and are practically nominal. Current quotations range at from $15 to $19 per ton; chrome salt cake at from $15 to $16 per ton, f.o.b., shipping point. Prices on imported salt cake at $18 per ton are nominal.

SODA ASH—Quotations on soda ash are firm under a moderate demand and are unchanged at prevailing market prices. Quotations on soda ash in car lots, per 100 pounds, are as follows: in bulk, $.90; in bags, $1.10; and in barrels, $1.35.

STARCH—Quotations on corn starch are reported unchanged this week. Globe pearl is currently quoted at $2.50 per 100 pounds; special paper starch at $2.60 per 100 pounds. All prices in bags, f.o.b., Chicago.

SULPHATE OF ALUMINA—Prices on sulphate of alumina are firm under a good demand. The commercial grades are currently quoted at $1.15 per 100 pounds; iron free at $1.45 per 100 pounds, in bags, f.o.b., Chicago.

SULPHUR—Quotations on sulphur are firm under a good demand and are unchanged at prevailing market levels. Annual contracts are currently quoted at $16 per long ton, f.o.b., mines. Spot and nearby car lots are quoted at $19 per ton.

TALC—Prices on talc are reported firm and to conform to prevailing market quotations. Domestic talc is currently quoted at from $15 to $18 per ton, Eastern mines. Imported talc is offered at from $23 to $45 per ton.

Market Quotations

Paper

(Delivered New York)

News, per ton—			
Roll, contract	$50.00	@	—
Sheets	58.00	"	—
Kraft—per cwt.—Delivered Zone A			
Northern, Extra Quality	$5.00	@	$5.50
Superstandard	4.62½	"	5.00
Northern Standard Wrapping	4.25	"	4.62½
Standard Wrapping	4.00	"	—
Tissues—Per Ream—Carlots			
White No. 1	.87½	@	—
White No. 1 M. G.	.85	"	—
White No. 1½	.70	"	—
White No. 2	.65	"	—
Anti-Tarnish M. G.	.75	"	—
Colored	.80	"	—
Kraft	.75	"	—
Manila	.65	"	—
Unbl. Toilet, 1 M.	3.50	"	—
Bleached Toilet	5.26	"	—
Paper Towels, Per Case—			
Unbleached, Jr.	1.85	@	—
Bleached, Jr.	3.20	"	—
Manila—per cwt.—C. l. f. a.			
No. 1 Jute	8.25	@	10.25
No. 1 Manila Wrapping, 35 lb.	5.25	"	—
No. 2 Manila Wrapping, 35 lb.	5.00	"	—
Boards, per ton—			
News	45.00	@	—
Chip	45.00	"	—
Sgl. Mla. Ll. Chip	57.50	"	—
Jute Lined Chip	57.50	"	—
White Pat. Coated	70.00	"	—
Kraft Liners	55.00	"	—
Binders Boards	76.00	"	87.00

The following are representative of distributors' resale prices:

Rag Content Bonds and Ledgers—White, Assorted Items, Delivered in Zone 1:

	Bonds		Ledgers	
100% Rag Ext. No. 1	$39.10	@ $46.00	$40.25	@ $47.25
100% Rag	31.05	" 36.50	32.20	" 37.75
85% Rag	....	"	29.90	" 35.00
75% Rag	23.60	" 27.75	24.75	" 29.00
65% Rag	....	"	21.65	" 26.25
50% Rag	17.55	" 21.50	18.70	" 22.75
25% Rag	14.65	" 17.75	15.80	" 19.25

Colors at $1.00 cwt. extra.

Sulphite Bonds and Ledgers—White, Assorted Items, Delivered in Zone 1:

	Bonds		Ledgers	
No. 1	$8.95	@ $11.00	$10.10	@ $12.25
No. 2	8.05	" 9.75	9.25	" 11.25
No. 3	7.60	" 9.25	8.50	" 10.75
No. 4	7.30	" 9.00	8.50	" 10.25

Colors $1.00 cwt. extra.

Free Sheet Book Papers—White, Cased Paper, Delivered in Zone 1:

No. 1 Glossy Coated	$11.90	@	$13.50
No. 2 Glossy Coated	10.35	"	11.75
No. 3 Glossy Coated	9.55	"	11.00
No. 4 Glossy Coated	9.15	"	10.50
No. 1 Antique (watermarked)	8.35	"	9.50
No. 2 Offset	7.70	"	9.00
A Grade E. F.	7.50	"	8.75
A Grade S. & S. C.	7.75	"	9.00
B Grade E. F.	6.95	"	8.00
B Grade S. & S. C.	7.20	"	8.25
C Grade E. F.	6.65	"	7.75
C Grade S. & S. C.	6.90	"	8.00
D Grade E. F.	6.40	"	7.50
D Grade S. & S. C.	6.65	"	7.75

Ivory & India at $.50 cwt. extra.

Mechanical Pulp

(On Dock, Atlantic Ports)

No. 1 Imported—			
Moist	$35.00	@	40.00
Dry	37.50	"	42.50
(Delivered)			
No. 1 Domestic and Canadian	40.00	@	42.00

Chemical Pulp

(On Dock, Atlantic, Gulf and West Coast Ports)

Bleached Sulphite (Domestic and Foreign)—			
Prime Bleached Sulphite	3.00	@	3.25
Prime Qualities—Easy-Bleaching Sulphite	2.85	"	—
Strong Unbleached Sulphite	2.75	"	—
(On Dock, Atlantic Ports)			
Kraft Bleached	3.00	@	3.25
Kraft Light & Strong	1.95	"	2.35
Kraft No. 1	1.85	"	2.20
(F. o. b. Pulp Mill)			
Kraft Domestic	1.60	"	2.12½
(Delivered)			
Soda Bleached	2.90	"	—

Add 60 cents per short ton, dock charges for Albany; $2.50 for Lake Ports East and $3.50 for Lake Ports West of Mackinac Straits. Also add extra freight charges and war insurance to all quotations on imported pulp.

Domestic Rags

New Rags

(Prices to Mill f. o. b. N. Y.)

Shirt Cuttings—			
New White, No. 1	7.25	@	7.50
Silesias No. 1	4.50	"	4.75
New Unbleached	7.25	"	7.50
Blue Overall	5.00	"	5.25
Fancy	2.25	"	2.50
Washables	2.00	"	2.15
Mixed Khaki Cuttings	2.75	"	3.00
O. D. Khaki Cuttings	3.25	"	3.50

Old Rags

White, No. 1—			
Repacked	3.25	"	3.50
Miscellaneous	2.75	"	3.00
White, No. 2—			
Repacked	2.50	"	2.75
Miscellaneous	2.00	"	2.25
Thirds and Blues—			
Repacked	2.00	"	2.25
Miscellaneous	1.75	"	1.90
Roofing Rags—			
No. 1	1.50	"	1.55
No. 2	1.20	"	1.27½
No. 3 (bagging)	1.50	"	1.60
No. 4	.60	"	.65
No. 5A	.60	"	.65

Foreign Rags

All prices nominal.

New Rags

New Dark Cuttings	2.25	@	2.40
New Mixed Cuttings	2.00	"	2.20
New Light Silesias	5.50	"	5.75
Light Flannelettes	5.50	"	5.75
New White Cuttings	7.00	"	7.50
New Light Oxford	4.00	"	4.50
New Light Prints	3.00	"	3.25

Old Rags

No. 1 White Linens	7.50	"	8.50
No. 2 White Linens	6.50	"	7.50
No. 3 White Linens	4.50	"	—

J. Andersen & Co.

Selling Agents

21 East 40th Street

New York

CHEMICAL & MECHANICAL PULP

Kraft Pulp

BERGVIK OCH ALA NYA AKTIEBOLAG
Söderhamn, Sweden
KALIX TRÄINDUSTRI AKTIEBOLAG
Vanaſjärden, Sweden
MUNKSUNDS AKTIEBOLAG
Munksund, Sweden
NENSJÖ CELLULOSA A.-B.
Sprängsviken, Sweden

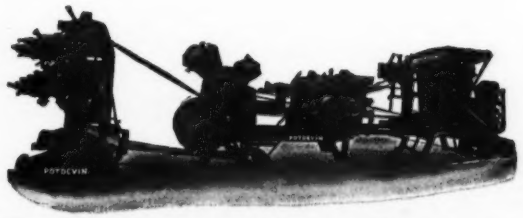
Bleached Sulphite

KELLNER-PARTINGTON PAPER PULP CO., LTD.
Sarpsborg, Norway
Edsvalla, Sweden
Hallein & Villach, Austria

Unbleached Sulphite

AKTIESELSKABET GREAKER CELLULOSEFABRIK
Greaker, Norway
BERGVIK OCH ALA NYA AKTIEBOLAG
Söderhamn, Sweden
CELLULOSEFABRIKS A.-G.
Bratislava, Czecho-Slovakia
SVANÖ AKTIEBOLAG
Svanö, Sweden

Business Starts With Buying



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. . . and it is good business to buy the best. POTDEVIN bag machines have behind them years of tried and proven worth. Practically every bag factory in the country gives witness to the satisfaction and dependability of POTDEVIN equipment.

POTDEVIN

PAPER BAG MACHINES

PRINTING PRESSES, WAXING MACHINES

POTDEVIN MACHINE CO.

THE DRAPER FELTS

All kinds and styles of Felts for all kinds and styles of Papers.

Write us about your Felt problems and let us help you reduce your Felt Costs—we will call anywhere at any time.

DRAPER BROS. COMPANY

CANTON, MASS.

Woolen manufacturers since 1856

ENGLISH ECCO CLAYS **CLAYS**

UNIFORM • SUPERIOR • DEPENDABLE

English China Clays Sales Corporation
551 Fifth Avenue, New York City

No. 4 White Linens.	2.25	@	3.25
No. 1 White Cotton.	4.25	"	4.75
No. 2 White Cotton.	3.25	"	3.75
No. 3 White Cotton.	2.50	"	3.00
No. 4 White Cotton.	1.90	"	2.20
Extra Light Prints..	2.00	"	2.40
Ord. Light Prints...	1.75	"	2.15
Med. Light Prints...	1.55	"	1.95
Dutch Blue Cottons.	2.25	"	2.50
French Blue Linens..	3.00	"	—
Checks and Blues...	2.00	"	—
Linsey Garments....	1.90	"	2.00
Dark Cottons.....	1.50	"	1.60
Old Shopperies.....	1.30	"	1.45
New Shopperies.....	1.45	"	1.50
French Blues.....	2.25	"	2.50

Old Rope and Bagging

(Prices to Mill, f. o. b. N. Y.)

Gunny No. 1—			
Foreign	2.50	@	2.75
Domestic	2.25	"	2.50
Wool Tares, light...	1.75	"	2.00
Wool Tares, heavy..	1.80	"	1.90
Bright Bagging.....	2.25	"	2.50
Manila Rope—			
Foreign	4.25	"	4.50
Domestic	4.25	"	4.50
Jute Threads.....	3.00	"	3.25
Sisal Strings.....	2.00	"	2.25
Mixed Strings.....	.70	"	.85

Old Waste Papers

(F. o. b. New York)

Shavings—			
White Envelope Cuttings	3.10	@	3.25
Ordinary Hard White No. 1....	2.25	@	2.50
Soft White No. 1..	1.80	"	1.90
Soft White Extra..	2.50	"	2.60
Flat Stock—			
Stitchless	1.10	"	1.25
Overissue Mag....	1.00	"	1.10
Solid Flat Book...	.80	"	.90
Crumbled No. 1...	.70	"	.75
Ledger White Stock.	1.60	"	1.70
Ledger Stock Colored	1.05	"	1.15
Manila—			
New Env. Cut....	1.70	"	1.80
New Cuttings.....	1.40	"	1.50
Old Kraft Machine— Compressed bales..	1.00	"	1.10
News—			
No. 1 White News	1.75	"	1.90
Strictly Overissue.	.70	"	.75
Strictly Folded....	.47½	"	.52½
Corrugated	.60	"	.65
No. 1 Mixed Paper..	.27½	"	.32½

Twines

(F. o. b. Mill)

(Soft Fiber)

Coarse Polished—			
India	.18½	@	—
White Hemp.....	.18½	"	—
Fine Polished—			
Fine India.....	.23	"	—
Unpolished—			
Box	.14¾	"	—
Paper Makers.....	.15	"	—
Tube Rope.....	.16¼	"	—
Wall Paper.....	.15¾	"	—
Wrapping	.18	"	—
Soft Fiber Rope...	.16¼	"	—
Cotton	.21	"	—

(Hard Fiber)

Medium Java.....	.19	"	—
Mex. Sisal.....	.16	"	—
Manila	.24	"	—
Domestic	4.00	@	4.50
Sisal Rope	2.25	"	2.50
Mixed Rope	.75	"	1.00
Transmission Rope ..	3.00	"	—
Soft Jute Ropes.....	3.25	"	3.50
Jute Carpet Threads.	1.25	"	1.50
Gunny Bagging—			
Foreign	2.50	"	—
Domestic	2.25	"	2.30
Bleachery Burlap....	3.50	"	3.75
Scrap Burlap—			
Foreign	2.40	"	2.50
Domestic	1.90	"	2.00
Scrap Sisal	2.25	"	2.35
Scrap Sisal for Shredding	2.50	"	2.60
Wool Tares, Heavy..	2.50	"	2.60
New Burlap Cuttings	3.25	"	3.50
Aust. Wool Pouches.	3.25	"	3.50
Heavy baling bagging	2.65	"	2.75
Paper Mill Bagging..	1.25	"	1.50
No. 2 Bagging	1.10	"	1.25

Domestic Rags (New)

(F. o. b. Boston)

Shirt Cuttings—			
New Light Prints...	.03¼	@	.03½
New White No. 1...	.08	"	.08¼
New Light Flannelettes	.05	"	—
Silesias No. 1	.05	"	—
New Black Silesias..	.03½	"	13¼
Soft Unbleached....	7.50	"	8.00
Blue Cheviots	.05½	"	.06
Fancy	.02	"	.08½
Washable	.02	"	.02½
Cottons—According to grades—			
Blue Overalls	.05¼	"	.05½
New Black, soft ..	.03¼	@	.04
Khaki Cuttings	.02½	"	.03
O. D. Khaki	03	"	.03¼
Corduroy	.02¾	"	.03
New Canvas.....	.06¾	"	.07¼
B. V. D. Cuttings...	.07	"	.07½

Domestic Rags (Old)

(F. o.b. Boston)

Canvas	.04¼	@	—
White No. 1—			
Repacked	—	"	2.75
Miscellaneous	2.50	"	2.75
White No. 2—			
Repacked	1.90	"	2.00
Miscellaneous	2.00	"	2.25
Twos and Blues	2.25	"	2.50
Old Blue Overalls ..	1.60	"	2.00
Thirds and Blues—			
Repacked	2.00	"	2.25
Miscellaneous	1.50	"	1.60
Black Stockings	4.00	"	4.25
Roofing Stock—			
No. 1.....	1.75	"	2.00
No. 2.....	1.60	"	1.65
No. 3.....	1.00	"	1.25

Foreign Rags

(F. o. b. Boston)

Dark Cottons.....	(nominal)
Dutch Blues.....	(nominal)
New Checks and Blues	(nominal)
Old Fustians.....	(nominal)
Old Linsey Garments.	(nominal)
New Silesias.....	(nominal)

PHILADELPHIA

Domestic Rags (New)

(Price to Mill, f.o.b. Phila.)

Shirt Cuttings—			
New White No. 1.	.07¼	@	.07½
New White No. 2.	.04	"	.04½
Light Silesias.....	—	"	.04½
Silesias, No. 1....	—	"	.04½
Black Silesias, soft	—	"	.03¾
New Unbleached..	.05½	"	.06
Washable, No. 1..	—	"	.04
Blue Overall.....	—	"	.05
Cottons—According to grades—			
Washable No. 2...	—	"	.02
New Blue	—	"	.02
Fancy Percales.....	—	"	.03
New Black Soft...	—	"	.04
New Light Seconds	.04½	"	.05
New Dark Seconds	—	"	1.50
Khaki Cuttings—			
No. 1 O. D.....	.03½	"	.04
No. 2 Mixed.....	.03	"	.03¼
Corduroy	—	"	.02½
New Canvas.....	.05½	"	.06
New Black Mixed.	—	"	.03

Domestic Rags (Old)

White No. 1—			
Repacked	3.50	@	4.00
Miscellaneous	2.75	"	3.00
Thirds and Blues—			
Miscellaneous	2.00	"	2.25
Repacked	2.50	"	2.75
Black Stockings (Export)	3.50	"	4.00
Roofing Stock—			
Foreign No. 1....Nominal			
Domestic No. 1..	1.50	"	1.60
Domestic No. 2...	1.35	"	1.45
Roofing Bagging..	—	"	1.30

Bagging

(f.o.b. Phila.)

Gunny, No. 1—			
Foreign .....Nominal			
Domestic	2.50	@	3.00
Manila Rope.....	—	"	4.50
Sisal Rope.....	1.75	"	2.00
Mixed Rope.....	1.25	"	1.50
Scrap—			
No. 1.....	2.50	"	2.75
No. 2.....	—	"	1.40
Wool Tares, heavy..	3.50	"	3.70
Mixed Strings	.75	"	1.00
No. 1 New Light Burlap	3.00	"	3.50
New Burlap Cuttings	2.00	"	2.25

Old Papers

(f.o.b. Phila.)

Shavings—			
No. 1 Hard Write	2.25	@	2.30
No 2 Hard White	2.00	"	2.10
No. 1 Soft White	1.85	"	1.90
No. 2 Soft White	1.50	"	1.60
No. 1 Mixed.....	.90	"	1.00
Solid Ledger Stock..	1.50	"	1.60
Ledger Stock, white	1.30	"	1.35
Ledger Stock, colored	1.00	"	1.10
No. 1 Books, heavy..	.90	"	1.00
Manila Cuttings.....	1.90	"	2.00
Print Manila.....	.70	"	.75
Container Manila...	.65	"	.70
Kraft Paper.....	1.00	"	1.10
No. 1 Mixed Paper..	.55	"	—
Straw Board Chip..	.50	"	—
Binders Board Chip	.50	"	—
Corrugated Board...	.60	"	.65
Overissue News.....	.70	"	.75
Old Newspapers.....	.55	"	.60

BOSTON

Old Papers

(f.o.b. Boston)

Shavings—			
No. 1 Hard White	2.25	@	2.50
No. 1 Soft White	1.85	"	2.15
No. 2 Mixed.....	.75	"	.80
Solid Ledger Books..	1.30	"	—
Overissue Ledger Stock	1.30	"	1.50
Mixed Ledgers.....	.85	"	.90
No. 1 Books, heavy..	1.00	"	1.10
No. 1 Books, light..	.65	"	.75
Crumpled Stitchless Book Stock.....	.55	"	.65
Manila Env. Cuttings	1.70	"	1.85
Manila Envelope Cuttings, extra quality	2.35	"	2.60
White Blank News..	1.40	@	1.50
No. 1 Kraft.....	1.10	"	1.20
Mixed Papers.....	.40	"	.45
Print Manila.....	.70	"	.75
Container Manila...	.60	"	.70
Old Newspapers....	.60	"	.65
Paper Wool Strings	.80	"	.90
Overissue News.....	.70	"	.75
Box Board Chips....	.52½	"	.55
Corrugated Boxes....	.60	"	.62½
Kraft corrugated boxes	1.00	"	1.05
Screening Wrappers	.60	"	.70

Bagging

(f.o.b.Boston)

Manila Rope—			
Foreign	4.25	@	4.50

TORONTO

Paper

Bonds

Direct mill shipment in two-ton lots.			
N. 1 White $35.50		@	—
No. 1 Tints	36.50	"	—
No. 2 White	25.50	"	—
No. 2 Tints	26.50	"	—
No. 2 Golden Rod..	27.50	"	—
No. 3 White	21.00	"	—
No. 4 White	15.00	"	—
No. 4 Tints	16.00	"	—
No. 4 Golden Rod	17.00	"	—
Direct mill shipment in three-ton lots.			
No. 5 White $10.50		@	—
No. 5 Tints	11.50	"	—
N. 5. Golden Rod..	12.00	"	—
No. 6 White	9.00	"	—
No. 6 Tints	9.50	"	—
No. 6 Golden Rod..	11.00	"	—
No. 7 White	8.00	"	—
No. 7 Tints	8.50	"	—
No. 7 Golden Rod..	10.00	"	—

Book—

No. 1 M. F.	$7.00	"	—
No. 2 M. F.	6.50	"	—
No. 3 M. F.	5.35	"	—
No. 1 S. C.	7.25	"	—
No. 2 S. C.	6.75	"	—
No. 3 S. C.	5.85	"	—

Coated Book & Litho

Ton Lots (resale)

No. 1 .....$12.00		@	—
No. 2	10.25	"	—
No. 3	8.90	"	—
Coated tinted.....	13.00	"	—
Wrapping—delivered—			
Rag Brown.....	4.85	"	5.25
White Wrap.....	4.00	"	—
"B" Manila.....	4.90	"	6.15
No. 1 Manila....	$5.50	@	$6.90
Fiber	5.50	"	6.90
Kraft No. 2.....	5.50	"	6.90

(f.o.b. Cars, Toronto)

News per ton—			
Rolls (contract)..	46.00	"	—
Sheets	54.00	"	—

Pulp

Ground wood.....$36.50		@	—
Unbleached sulphite	54.00	"	—
Bleached sulphite...	64.00	"	—
Kraft	47.50	"	—
Soda	58.00	"	—

Old Waste Paper

(In carload lots, f.o.b. Toronto)

Shavings—			
White Env. Cut..	2.15	@	—
Soft White.....	2.00	"	2.15
White Blk. News..	1.35	"	1.50
Book and Ledger—			
Flat Magazine and Book Stock (old)	.90	"	1.00
Light and Crumpled Book Stock.....	.80	"	.90
Ledgers and Writings	1.15	"	—
Manilas—			
New Manila Cut..	1.55	"	1.60
Printed Manilas...	.77	"	—
Kraft	1.15	"	—
News and Scrap—			
Strictly Overissue	.75	"	—
Strictly Folded ..	.70	"	—
No. 1 Mixed Paper	.60	"	—

CHICAGO

Waste Paper

(f.o.b. Chicago)

Shavings—			
No. 1 White Envelope cuttings..	2.40	@	—
No. 1 Hard White	2.23	"	—
No. 1 Soft White	2.00	"	—
Ledger and Writings	1.20	"	—
Solid Books.....	.95	"	—
Blanks	1.70	"	—
Krafts	1.00	"	—
New Kraft Cuts.....	1.60	"	—
Overissue News.....	.80	"	—
Old Newspapers—			
No. 1 Folded News	.73	"	—
No. 1 Mixed Paper	.63	"	—
Roofing Stocks—			
No. 1	1.25	@	—
No. 2	1.15	"	—